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FINAL REPORT

OVERVIEW AND EVALUATION OF SYSTEMS MODELS

FOR NATIONAL FOREST LEVEL PLANNING

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CHAPTER I

INTRODUCTION

A. Statement of Problem

The National Forest Management Act of 1976 requires development of comprehensive land management plans for the National Forest System. The Act specifies that National Forests complete plans by 1985. Thereafter, the plans are to be updated every 15 years. A planning process to meet this need is currently being formulated and regulations describing this process are now available. To refine the procedures and provide guidance for future efforts several prototype Forests plans are being constructed. The USDA Forest Service Systems Application Unit for Land Management Planning (SAU-LMP) is assisting prototype Forests in this effort. It is expected that several analytical aids will be utilized and many are currently available (SAU-LMP) for use in the various phases of planning.

The research problem was to analyze thoroughly the Forest level planning process from a conceptual point of view and develop recommendations for the use of a specific set of system models in this planning process. A multitude of various techniques is needed in order to better construct a workable, efficient planning system. Strengths and weaknesses of various approaches need to be clarified in the context of Forest level planning. Where and how these techniques should interface with one another needs to be clearly understood by potential users.

B. Objectives

- 1) To develop a conceptual framework for Forest level planning.

- 2) To identify analytical tools which are appropriate to the conceptual framework and analyze their various strengths and weaknesses.

C. Procedures

This study progresses through three critical areas. They include:

- 1) conceptualization of the forest level planning framework;
- 2) identification and evaluation of analytical techniques; and
- 3) application of recommended techniques to a hypothetical National Forest.

Conceptualization of the Planning Framework

An overall conceptual framework was developed for Forest level planning and this framework is described in Chapter II. The new regulations based on the National Forest Management Act of 1976 (NFMA) and the Resources Planning Act of 1974 (RPA) were considered as they related to this planning process. In addition to USDA Forest Service input other state and federal land management agencies, such as the Bureau of Land Management were consulted concerning their planning process. Published sources dealing with land management planning, and planning as it related to management in general, have been referenced to insure as complete a coverage of current literature as possible. The conceptual framework is described in narrative as well as graphical fashion.

Identification and Evaluation of Analytical Techniques

After constructing a conceptual framework various techniques and tools were identified which might be applied to aid in completing aspects of the planning process. These include techniques used primarily in an informational mode as well as those used for analysis. The tools and

techniques are discussed in categories of public involvement, development and analysis of alternatives, and evaluation of alternatives in Chapters III, IV and V, respectively. The emphasis here was on existing techniques available within the USDA Forest Service and how they interface in the planning process.

An evaluation was made of the various tools specified in the study of the conceptual process. The strengths and weaknesses of each were outlined in the context of the needs of Forest level planning. This evaluation was based on several possible criteria including needs of the planning process, requirements of the NFMA regulations, ease of use, and interfacing with other models.

To a limited extent simplified examples were used to illustrate more salient aspects of specific models. For the most part, however, the evaluation was made based on program documentation, published sources, discussions with SAU-LMP and other agency personnel, and consultations with past and present users of the techniques.

Based on this review a set of techniques was recommended for use in the planning process. The basis for this recommendation was documented and aspects considered important to proper use of the techniques were presented.

Application of the Recommended Techniques to a Hypothetical National Forest

In scenario form the recommended tools were applied to a hypothetical National Forest. This hypothetical application is general enough as to be applicable to many National Forests throughout the United States. The simplified example is an easy to follow "familiarized" description of the planning process and how the recommended tools are used in that process.

CHAPTER II

A Conceptual Framework for Forest Level Planning

The development of a conceptual planning framework for forest level planning requires consideration of a great many factors. This chapter will review general concepts of planning, the dimensions of planning, forms of planning organizations, decision making theories, and management functions as they relate to development of this framework. A historical background will be outlined to give the reader a basic perspective concerning those pieces of legislation which have influenced forest planning. Finally a conceptual framework for forest planning will be diagrammed and reviewed to point out the purpose and task of each phase, the NFMA regulations to which they correspond, and the tools or techniques which might be employed to help complete them.

A. The Nature and Dimensions of Planning

Planning may be defined as an activity concerned with the systematic collection, analysis, integration, organization and processing of technical information to facilitate decision-making. Another definition suggests that planning represents the self-conscious attempt by man to order his environment so as to realize common goals and values. Planning has as its objective the accomplishment of general organizational goals, and is primarily concerned with providing technical information for decision-making, plan implementation and control. The planner then, examines alternative solutions to a problem and the ramifications which result from each. Based on this investigation that alternative which will optimize the

attainment of the desired state will be chosen. In essence, the planner reviews differing means and actions necessary to fulfill the objectives of the organization (Banfield).

1. Nature of the Planning Activity

The first and most basic obstacle interfering with effective development of organization long-range planning stems from confusion about the nature of this activity and what should and should not be expected of it.

Planning is not forecasting. Planning is necessary precisely because we cannot accurately forecast. A forecast is a prediction or projection of future events or conditions. Forecasts are essential to planning activity but they are not themselves plans. Forecasting attempts to find probable courses of events, or a range of possibilities. Upon the basis of such forecasts planning can proceed to determine the best alternative course of action to achieve organization objectives.

Planning is also not an attempt to eliminate risk in decision-making (Ewing). It is intended to understand the nature of risks which exist and to develop the capacity to function within them. Planning is a guide-book for the future of an organization. Planning is more of a navigational chart which when used allows rational adjustments to a changing environment. Planning then, should be dominated by flexibility to alter current decisions so as to take advantage of those changes.

The act of planning serves to focus the attention of the organization on its overall objectives. By constantly comparing decisions to the objectives outlined, managers become very conscious of the objectives. Given the fact that most policies, procedures and programs are departmentally related in scope, this all-encompassing focus is of extreme importance. These central

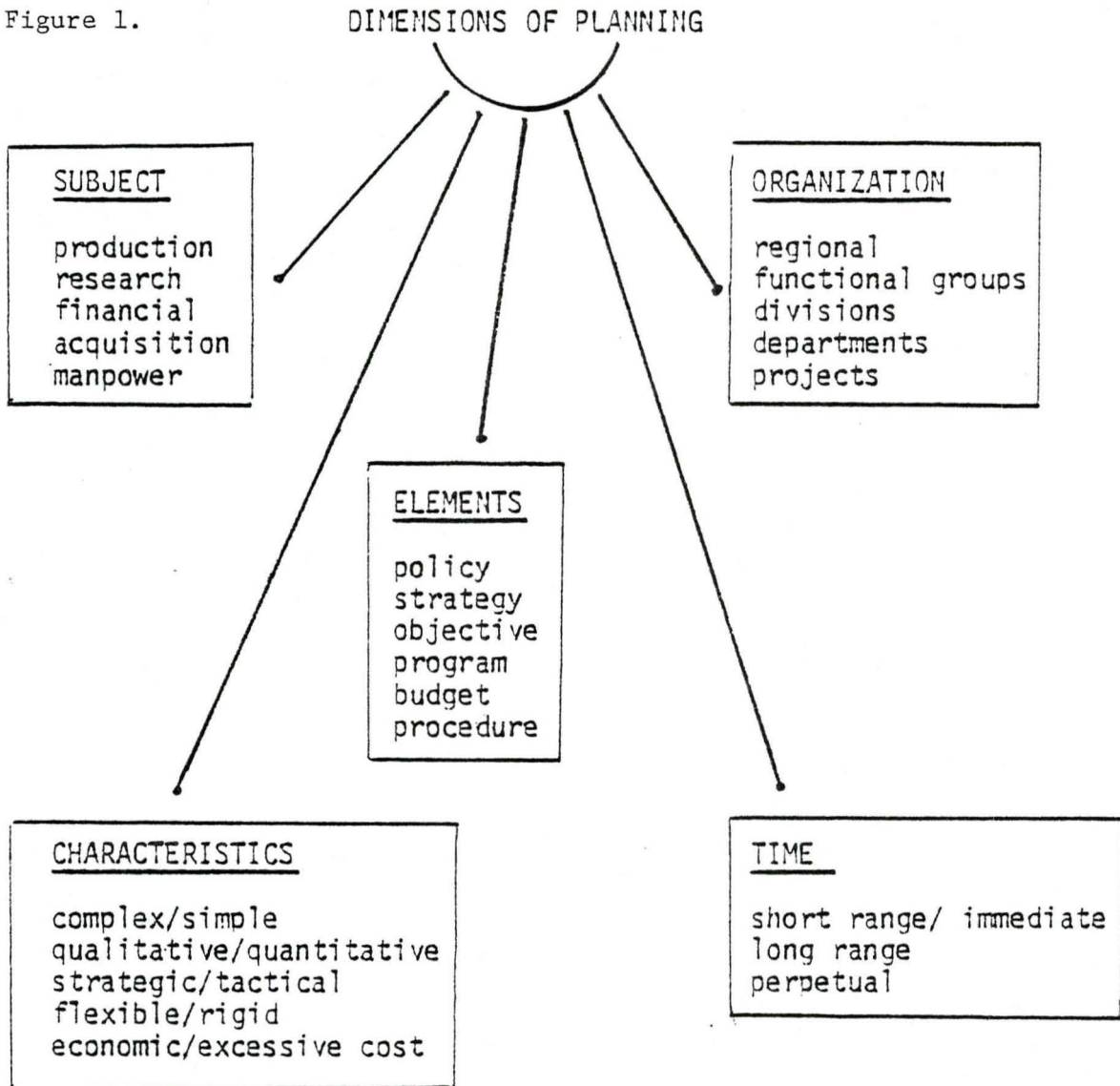
goals serve to orient departmental goals toward a common position, preventing the development of non-consistent objectives within the organization (Ewing). A major benefit of well-drawn planning is that it orients the activities of departments toward one objective and as such restricts the freedom of development of singular departmental plans. This singular nature was evident in the USFS functional plans of the past. A well-considered plan also directs the attention of managers past the more immediate issues and problems toward the future and helps to isolate the need for plan revisions. "Managerial planning attempts to achieve a consistent, coordinated structure of operations focused on desired ends" (Ewing).

The unified focus provided by planning on attainment of objectives can serve to direct effort and orient it toward the integration of resource considerations. Due to the decisiveness which can result from utilizing a good plan, an efficient and coordinated organization develops that minimizes costs and time spent.

2. Dimensions of Planning

Figure 1 displays the dimensions of planning. The dimensions displayed are evident in Forest Service planning. For example, organizational planning in the Forest Service concerns establishing relationships or links between national, regional and forest level planning. The National Forest Management Act and regulations help define these relationships and the responsibilities of each link. The time dimension is also specified in the regulations requiring a plan covering five decades be prepared every 10 years.

Figure 1.



(from Steiner, Top Management Planning)

The overall point here is that many types of plans may exist at varying levels of scope and degree of detail. A design for planning at the broad organizational level is not necessarily satisfactory for the concerns of planning a solution to an immediate short range, short-term problem.

3. Pre-planning

An important responsibility of all top management is to plan the organization for planning, pre-planning. Because all line managers have some planning responsibilities and most staffs also become involved in the organization planning efforts, decisions must be made about which duties should be assigned to which people, what authority each should be given, and what results should be required. In short, comprehensive planning must be organized.

4. Forms of Planning Organizations

There are several possible forms for planning organizations -

- 1) An organizational structure with planning authority in separate functional areas not oriented toward a central goal. This situation is particularly common to decentralized departments within a small organizational structure.
- 2) Organized planning with functional areas of an organization later oriented toward overall organizational goals.
- 3) Planning power riding in the departments or divisions of an organization who report to a chief executive. Thus, no planning staff division exists and planning is aimed at a single central office.

- 4) A single organization planning department which reports to the executive. As such no planning personnel are located within each functional office, and the planning staff involves itself with the detail of each area.
- 5) A planning officer exists in each department or functional area, who operate through a centralized planning staff.

As a planning system evolves, care must be taken to assure that each manager understands his part in the process and accepts it as being important in doing his job. If a manager does not see the program as being important to his job the whole process becomes just another exercise in paperwork. On the other hand, it can and should be the basis for better decisions and assure the contribution of each manager to achieving the ends sought for the organization.

5. Role of the Organization Planning Staff

In the realm of planning the use of publicly owned resources the planning staff must recognize and integrate the input of the many participating groups. These groups include subject matter experts, interest groups, program analysts, plan builders and finally those holding decision power, the decision-makers (Wagar). The integration and coordination of inputs from these groups is one of the primary roles of the planning staff.

Subject matter experts provide the necessary special knowledge to facilitate complete understanding of the consequences of proposed actions through provision of data and their expertise in its interpretation. Interest groups serve to unify those persons holding a particular view which may oppose or support one or more proposals for management. Their power as

a representative body enables them to further their particular perspectives on the issues confronting the planning staff. The technical assistance provided by program analysts helps the planning staff to isolate data and information requirements as well as ensure efficient and coherent solutions to particular problems. Their skills will frequently encompass quantitative techniques and computer-based procedures for analysis. Plan builders or designers are responsible for combining information and assistance from the above three groups to formulate specific planning alternatives which are not only technically possible, but politically and economically feasible as well. A primary role here is to isolate combinations of management actions within the complexity of the planning effort. The role of plan designers is further constrained by those who must make choices. The decision-makers are responsible for choice and successful implementation of the chosen plan.

Within the USFS a team is normally required to support and control the input of all these actors or participating groups in the planning effort. This team must recognize and understand the technical and biological complexity of the system they are working within as well as the sociological, political, and administrative forums which influence the planning efforts, from inside as well as outside the organization. Responsibilities of the interdisciplinary team are listed in Table 1.

Table 1. Roles or Reasons for an Interdisciplinary Team

- a. aid in development of organization objectives
- b. development of strategies in response to objectives
- c. coordination of efforts
- d. make members of the groups aware of their special,
appropriate and timely roles

- e. aid formal planning within and among departments
- f. seek or forward a flow of meaning rather than detail of information
- g. preparation of organization strategic plan with the cooperation of department managers and executive officials

The planning staff may be responsible for assisting top management in developing long-range objectives, strategies and policies to reach them. The staff also assists by preparing fundamental studies that may lead to strategy recommendations. The staff may also assist departments with their planning in response to the overall top management strategy. As such, the staff would seek some uniformity in plans between departments and evaluate their efforts to insure their directions are consistent with organization objectives.

6. Day-to-Day Management Functions Which Support Planning Activities

The management activities discussed above relate to the basic end products for which management is responsible. Each of these activities is completed over time in a systematic process of moving through the planning steps. The more day-to-day functions of management pertain to the efficient and comprehensive administering of these components. These day-to-day management concerns will be Briefly addressed from the standpoint of the organization as well as from the perspective of the planning staff.

From the perspective of the organization management holds the responsibility of utilizing resources in an organized fashion to accomplish the planning activity. These resources include personnel, money, equipment and materials. The use of these resources is guided through organizing, coordinating, directing, and controlling. In broad terms these constitute the functions of management.

Organizing is concerned with the division of work to be accomplished, and grouping this work by function. The grouping of this work by function serves to minimize effort and the use of resources. That is, organizing helps to develop a process and structure to complete the work and aids in appointing the resources mentioned above to appropriate and efficient use. Organizing then, serves to designate working groups, their responsibilities, and their relationship to other groups. The relationship between these groups also helps to define the flow of communications.

At the forest level, this organization may take the form of a forest planner/planning team responsible for the day-to-day task of developing a plan. This development is guided by a core interdisciplinary team composed of representatives of functional areas such as wildlife, recreation and timber, and technical specialists in the areas of operations research, economics and sociology. The program is carried out on a day-to-day basis by the planner/planning team which requests assistance from the functional areas within the ID team.

Once this structure and process of organization is accomplished the groups which are developed may be represented in an organizational chart. The chart represents the grouping of functional work into units, the channels of communication which are developed, and the responsibility that has been delineated. This is all done in an effort to ensure that the objectives of the organization are clear and each group or unit understands its relation to the whole.

In planning situation organizing applies to the planning team as well as the working groups. It is the responsibility of an administrative body to appoint a program development team. This team is responsible for delineating the work load into functional units to promote efficiency in the use of

resources. It may be that functional working groups have been previously developed representing, for example, accounting and public relations, or perhaps, timber management, recreation, and grazing and so on. The program development may be composed of representatives from these groups who report on their particular area. The team may define the jobs of each of these groups, delegate authority and responsibility, draw lines of communication and assign personnel and other resources to the groups. It is through this organization that the objectives of the planning program can be passed, along with the role of each working group in responding to those objectives. The organization sets the pattern for staff relationships, channels of communication, the development of assignments and finally the 'product' which the working groups are to complete and report on.

The coordinating function is aimed at developing a unified purpose within groups as well as the organization as a whole. This involves relating the flows of information and decisions between groups in a timely and appropriate fashion to facilitate the functions the group has been assigned. For example, the analysis of the management situation on a forest requires the prior construction of an information system. This system must provide necessary data and information in an appropriate fashion. Those responsible for the analysis must convey their anticipated information needs in detail to the operations analyst. Otherwise, data compiled may not be that is required for the analysis.

Coordination, in a planning context, requires representatives of working groups, in conjunction with other members of the planning team and the administrative group, to adopt procedures which maximize the use of resources by the group and the organization as a total body. Coordination requires processes which will serve to unite the efforts of working groups in harmony with all other groups.

Controlling is concerned with assuring through review and evaluation that the evolution of plans and their implementation is meeting the goals established. It is used to ascertain whether resources are appropriately and efficiently used and that work is progressing on time. The tasks established for each group should be scheduled and coupled with required standards to track costs, quantities and qualities of work completed. Control measures include progress reports, staff meetings, scheduled reviews, etcetera. Problems which may arise in the completion of tasks should be brought out immediately to make corrective action possible and effective. Obviously, good control requires specifying clear responsibilities to the individual groups.

When utilized in a planning situation control requires a early selection of review measures. These measures or standards should be developed at the functional area level as well as the planning team level. In other words, all groups or teams are given a schedule of completion dates as well as an outline for the types of products to be completed. This set of standards is constructed and passed to appropriate staff members so all are aware of the expectations of superiors. When all staff members are fully aware of the expectations they can efficiently guide their work and ensure their progress is that which is desired. At the same time they are able to spot potential trouble spots early. From this standpoint, controlling requires a well devised communications flow throughout the planning network.

Directing is aimed at making sure the designated tasks of each group are well executed. This requires instruction, training and supervision. Regardless of the set of tasks and responsibilities for a group, direction is required to ensure the group knows how to handle and address these tasks. Direction must deal with how to motivate group members, how to communicate with

the members and what level of detailed assistance to provide. In the Forest Service planning case direction must be derived, in part, from careful interpretation of the NFMA regulations. Procedures to implement the regulations are forthcoming in technical handbooks.

Through organization and coordination the role of groups and their use of resources is specified. Managerial directing of these groups and the planning team provides the instruction and guidance on how to accomplish assigned tasks, how to work in conjunction with other groups, and how to remain on schedule. Directing is a teaching and awareness process which assists staff members in fully understanding their assignments. The planning team must make very clear their directives for the organization and each group leader must possess the skills to transform these directives into work-day tasks which are clear and promote enthusiasm in staff members.

The explicit consideration of all these functions: organizing, coordinating, controlling and directing, can serve to create the atmosphere of efficiency which can instill a high level of motivation for those working in the planning effort.

Motivation of staff members requires the recognition on the part of the manager and the planning team that each individual staff member is seeking to complete his responsibility to the organization as well as meeting personal goals. The manager should take this knowledge of the individual and put it to work by, if possible, aligning the individual in a position which best suits his particular interests and abilities and sustains this with a level of challenge. To maintain the quality of work expected the manager should make well known his goals for the staff as well as establish a quick, effective and fair procedure to criticize or reward performance.

This sense of interaction between managers and staff members can encourage teamwork and cooperation within the working groups as well as the entire organization. It may serve to broaden these staff members' understanding of the problems at hand and foster innovation and creativity on their part. Improvements or changes to the status quo such as new policies and procedures developed by managers or staff should have a means through which to be quickly reviewed and disseminated. All of these efforts should be oriented to improve the individual's development and his sense of useful participation. In forest level planning passage of NFMA and the subsequent series of draft regulations has posed problems for forests in maintaining a clear planning direction. The policy and procedural changes embodied in the sequence of regulations has led several forests to conduct in-house seminars regarding how these changes effect their situation. These have helped to encourage comment, understanding, and maintenance of "esprit de corps" in light of the confusion surrounding these new approaches.

A manager's actions and efforts should foster an individual's ability to accept responsibility when delegated to him, to fully understand what the responsibility entails, and to sense an awareness that his personal contributions are ready to be heard. A procedure should also be adopted by the manager to make accomplishments known and rewarded as well as a system to enable the staff to benefit from their mistakes.

The manager, like other staff members, is responsible for contributing to the overall objectives of the organization. It is his role to facilitate the operations of the planning staff, through a variety of means discussed above, to ensure each individual has complete knowledge of this tasks.

B. Decision Making Theories

In the previous sections factors relating to the nature and dimensions of planning activities were discussed. This section will be followed by a brief discussion of the development of federal laws governing Forest Service management activities. How decisions are made within the planning segment of the overall decision making process leads to differing theories concerning how decision making is approached through planning. Decision making, in the context of land management planning, runs the spectrum from short term problems to long term, strategic problems with high levels of uncertainty associated with them. Given this range of possibilities, no single decision making process can provide the necessary structure which would apply to all situations. Instead a combination of decision making processes is required. These decision processes may be viewed as alternative approaches which may help to develop an operational planning process. It is possible that a process might be developed which incorporates various elements of these decision theories. Several differing decision processes will be examined to establish their advantages and disadvantages to functions of management and planning at the forest level.

1. Rationalism

The rational decision process is based on the idea that man is able to recognize all the possible alternative solutions to a problem as well as all of their consequences and make an objective choice between them. The choice is made based on a ranking of the alternatives, and that alternative chosen will always be the optimum. However, as time and resources seldom permit an 'all-knowing' situation, and because certain constraints often prohibit certain choices this is usually an impossible situation. The process precludes

adaptive behavior to additional information which may clarify the problem(s). Due to the strict reliance on the step-by-step approach no review and evaluation of the effectiveness of progress to date and feedback is possible. The rational approach also suggests a centralized decision-making body which, given all the consequences of all the alternatives, can represent the whole of society in its ranking of alternatives. In Forest Service development of alternative plans the rational theory would require the ID team to identify all possible alternatives, all possible consequences, and complete utility-ordering for all possible sets of consequences (Chadwick). This can be accomplished only under conditions of complete certainty regarding information and future conditions. In the "real world" this may be used only in the case of very short term plans, not for planning over many decades.

2. Bounded Rationality

Given the near impossible requirements for information and knowledge dictated by the purely rational process above, bounded rationality represents a more practical approach. This process requires one to act rationally with regard to the more limited perception of alternatives and their consequences. In the act of following this procedure, as more information is learned one may be able to adjust his decision. The approach requires a set of criteria which will assist in choosing alternatives, limiting the set of alternatives under consideration to those which meet some minimal level of achievement. This approach leads to a more 'satisfying' type decision than a 'best' decision. In the context of forest management bounded rationality would constitute a strategically oriented planning process. Effort would be concentrated on development of long range plan alternatives for 40 to 50 years and revisions

where necessary to incorporate perceived change in national, regional and local demands for goods and services. However, limited attention would be given to revisions in annual management activities which in sets, form the alternative plans.

3. Incrementalism

Incrementalism is a decision approach which considers the existing state of affairs along with alternatives which are only marginally different. Thus only alternatives with consequences that differ marginally from the status quo are considered.

One of the major benefits of the incrementalism approach is its conformity to man's ability to solve complex problems. One doesn't normally possess sufficient time to isolate wide ranging alternatives nor have the resources to develop them. In selecting a set of limited alternatives close to the present situation, one is involved with alternatives whose consequences are easier to predict. Finally, since alternatives are close to the present state, decision-makers are considering familiar situations and can therefore provide more input containing operational aspects. However, because the alternatives considered are similar to the status quo, past conditions can be perpetuated, good or bad, with little real change. Furthermore, this process requires little analysis and is thus not dependent upon use of sophisticated management tools. In the case of the Forest Service incrementalism as a planning design would produce short term planning alternatives and associated consequences very similar to past actions. Implementing such plans would require little if any redesign of the organization, functions of personnel or management activities. Involvement of publics in requesting changes in the plan could be easily adopted. However, radical

changes in the design of the organization or the adoption of new system tools would be greatly hindered. The process would also neglect consideration of long term goals and plans.

4. Mixed Scanning

Mixed scanning requires the decision-maker to "scan" the field of alternatives including those not immediately recognized as feasible. This field of alternatives is then evaluated in an iterative fashion until it is narrowed to one or several choices which are possible. The procedure allows for readdressing issues and goals as the alternative is implemented. In the process an attempt is generally made to postpone the more permanent decisions to later in the implementation process. This allows for feedback of information gained through review of results of previous actions. This may prevent implementing an irrevocable course of action which results in an undesirable outcome, an action not possible in the previous process. In the context of forest planning the mixed scanning approach allows the ID team to simultaneously consider two aspects of planning, the long and short term. The ID team would build long term goals perhaps for 40 or 50 years through "scanning" national, regional and local demands for goods and services. Based on these goals the ID team could work to develop short term programs, 5 to 10 year sets of management activities designed to reach these goals. The ID team could, with public interaction, reconsider and if necessary reorient these short term programs. With time and reassessment of demands the team could once again "scan" for more basic changes in these demands and redesign the long term goals. The process makes the total planning effort highly receptive to change in social, economic and environmental systems.

A range of decision making processes have been presented, from rationale to incrementalism, each holding a different view of what is logical and achievable in planning. It may also be found that within an organization not one, but several of these decision processes may be employed in decision making. Thus, certain areas of management and planning reflect incrementalism processes whereas other parts might reflect centralized rationality. The selection of the approach would depend on the type of plan and its functions; i.e., strategic versus tactical, entire forest versus a plan for implementing a controlled burn. In general, the management process selected for resource management should provide a structure which can:

- a. 1. identify management functions;
- 2. organize and coordinate the use of management tools and concepts;
- b. be translated in terms compatible with the management of the particular entity, environment, or problem area;
- c. identify the tasks of each functional component, described to specify its conceptual content and linkages to other components.

(Mitchell)

This structure defines concepts discussed in the initial segment of this report and are, in effect, summarized in the above list. Given the laws which will be discussed shortly and the NFMA regulations, a specific set of requirements for a conceptual planning framework can be formulated.

The recommended decision making theory for Forest Service planning is mixed scanning. The mixed scanning approach accommodates both the long and short term, strategic and tactical, aspects of planning. Mixed scanning allows setting long term goals and plans which serve as targets for the ID team. The short term plans operationalize the long term goals.

They also set the stage for revision of long term goals through success ratings and frequent public feedback. In this process tools such as linear programming models which can analyze long term goals are easily incorporated. Sets of short term management activities, also used in linear programming, can be evaluated in the context of satisfying these goals. In this manner both tactical management activities and the possibilities of attaining long term goals can be estimated and presented for public review. This approach may also help in designing short term plans and component activities which are more interdisciplinary in nature.

C. Historical Perspectives of Planning in the U.S. Forest Service

Management of public lands in the United States requires knowledge of the demands for resources and the capacity of the land to supply these uses. Many times these uses compete with one another thus making the resolution of issues surrounding land use very complex. The decisions which control the future use of land require careful planning with knowledge of costs and benefits of the competing uses.

1. Legislative Background of Forest Service Planning Activities

In 1891 the General Revision Act gave the President power to reserve certain timber lands in the public domain. Management and planning on these lands has evolved over the years from an orientation toward maximizing single uses to one integrating resource use. This evolution has taken management up to the present in terms of the National Forest Management Act (NFMA) which requires an integration of management and planning of all the uses and resources of national forest lands. NFMA with the Resources Planning Act (RPA) specifies that coordination and integration of forest level plans with RPA programs must be accomplished to make operational planning responsive to program budgeting.

Since the beginning of the Forest Service legislation governing its responsibilities and actions have been altered to reflect a changing concern on the part of the American citizenry. This legislative direction has changed over the years to accommodate a growing awareness of our needs as a nation as well as an improved knowledge of the capacity of natural systems to meet these needs.

The Organic Act of 1897 was a compromise between western interests and conservationists of the progressive conservation movement of the late 1800's. The Act called for the "forest reserves" to provide watersheds and continuous timber supplies for the nation. The Act set aside of these "forest reserves" was a direct turn-about of federal policy emphasizing a new federal management role and federal land reservations in place of the previous "homesteading" programs.

Since passage of the Organic Act there has been increased development of resources and number of plans necessary to guide use of these resources. Over the years these uses came to include increased demands for water, timber, and grazing but also wildlife and recreation. Demand for resources was heightened following World War II to meet a growing requirement for housing and recreational opportunities. The management direction up to this point was directed at specific resources under the guise of the Secretary of Agriculture's statement in 1905 of managing the resources so as to provide the "greatest good to the greatest number in the long run."

The four laws which were to have the greatest impact on the current resource management/planning process were the Multiple Use - Sustained Yield Act of 1960, the National Environmental Policy Act of 1969, the Forest and Rangeland Renewable Resources Planning Act of 1974, and the National Forest Management Act of 1976.

Prior to the Multiple Use - Sustained Yield Act of 1960 the Forest Service realized the multiplicity of resources but management was most often slanted toward timber resources with little national public debate on the issues pertinent to management. Wilderness concern generated some controversy with particular regard to the Gile National Forest (1924) and the Quetico-Superior (1929). By in large there were no major issues concerning the multiple uses of the federal lands. With the adoption of the MU-SY Act, the first major legislation since 1897, the resources, while managed simultaneously, were to receive comparable consideration in management decision making. The Act specifically called for the multiple-management of timber, range, fish and wildlife, along with water and recreation uses utilized in combination to "best meet the needs of the American people w/o impairment to the land with consideration being given to the relative values and not necessarily the greatest dollar returns or greatest unit output." The law did, however, recognize that while equal consideration was required for all resources, certain situations on a local basis could involve priority uses.

The law, however, did not specify how this multipleuse management was to be done. The stage was set of the incorporation of the multiple use concept in planning, but there was no operable system presented to accomplish it. Further refinement of this law, through later legislation discussed shortly provided more legislative guidance to help specify how coordination of resource uses would be accomplished.

Multiple use plans were developed for each forest on a district level. The plans gave broad direction for these units of the forest and attempted to provide integrated management for the predominate resources in the unit.

For the most part planning was nevertheless aimed at maximizing the production of traditional individual resources. The result was not true integration of planning for multiple resources but instead the acknowledgement of the impact of a set of singular resource objectives on the other resources in the system. Indeed, frequently a dominant use prevailed as the driving force behind management plans after which other uses were considered.

Planning as part of the management of resources in the Forest Service received direct attention in 1969 with the passage of the National Environmental Policy Act (NEPA). NEPA brought about a reformulation of the planning methods developed in response to the Multiple Use - Sustained Yield Act. NEPA grew out of a blossoming interest of people in the welfare of the environment. Man's use of the environment resulting in air and water pollution spurred this concern. This concern resulted in some federal projects landing on courtroom dockets. Prior to 1969 legal standing in federal courts was granted only if the complainant could demonstrate economic losses due to agency actions. After 1969 esthetic or conservational interests were held to be legally viable bases for bringing the agency to court. The Act directly confronted these issues arguing for an indepth consideration of the welfare of man's environment; an increased understanding, and thus appreciation for the effects of man's use of the environment. The Act precipitated an effort to build an improved knowledge of the 'workings' of the natural system and the impacts of man on these systems.

NEPA required environmental impact assessments including an integration of social and natural sciences in planning and decision-making. Thus, NEPA required the use of an interdisciplinary analysis approach considering

the diversity and interrelations of resources, management programs, and environmental impacts. The management system was to develop methods and procedures which would assure consideration of amenity and aesthetic values along with technical and economic criteria. The law required an assessment of individual projects, regulations, legislative proposals and policy statements to determine their impacts on the natural systems and environmental quality.

The planning procedures developed in the Forest Service in response to NEPA were efforts to provide individual forests with guidance from regional and national levels. The process was also constructed to develop draft environmental impact statements (EIS) where necessary.

The Resources Planning Act, when enacted in 1974, set the stage for development of long range planning in the Forest Service. The Act grew out of environmentalist's action in the early 1970's which led to more legislative guidance for the Forest Service. The Act specifically called for an assessment of renewable resources in forest lands and range lands. This assessment was to provide the basis for a National Renewable Resources Program under which future resource management would be directed. The Assessment was to address present and forecasted use of renewable resources and the estimated ability to satisfy these uses. The Assessment was also to list opportunities for improving land and resource outputs and stressed relating "expected output and benefits to investment costs". Finally, it was required to define policy, law, and institutional arrangements which influence current usage and would impact future use. Overall, the Act was designed to re-address planning and budgeting in national forest management, make planning more responsive to public participation, and more inter-

disciplinary in nature. The Act stresses economic evaluation and in that respect differs somewhat from the MU-SY Act. The regional directives for planning were initially formalized under RPA as "Area Guides".

2. The National Forest Management Act of 1976

The National Forest Management Act of 1976 (NFMA) was aimed, among other things, at amending planning requirements of RPA and providing more specific guides for management activities. At the same time the Act does allow for flexibility and professional judgment to be applied in constructing management alternatives. NFMA was a result, in part, of a court case in 1967 involving the selling of timber on the Monogahela National Forest. The courts ruling on this case found the USFS illegally selling timber under the auspices of the Organic Act which indicated "dead, physiologically mature, and large growth timber" individually marked could be sold. The controversy which ensued surrounding this court case led to Congress repealing various clauses in the Organic Act and the NFMA being legislated. The significant areas of direction provided by NFMA address land management planning, timber management, and public participation. RPA stressed the need for a long-term budgeting process to support implementation of resource plans. Public involvement was stressed in NFMA promoting maximum participation in the developmental process of land use plans. Planning for each forest is to be completed every 15 years, with the first plans completed by 1985. The plan must be an integrated resource plan which must be available for public review.

Proposed regulations for NFMA were issued May, 1979 for review after the initial appearance of draft regulations in the Federal Register in August, 1978. The final regulations, published in September, 1979, to become effective October, 1979, set guidelines which establish the process

for the development of land management plans. These regulations indicate the need for interdisciplinary teams and economic analysis in developing management plans with the active involvement of the public.

In summary, it may be stated that the National Forest Management Act is directed at unifying programming and planning efforts between the national, regional, and forest levels of the Forest Service.

D. A Conceptual Framework For Forest Level Planning

The drafters of the NFMA regulations describe the criteria used for rating alternative planning processes and selecting a preferred alternative (Sept. 1979, p. 53953). The rating criteria emphasized that congressional intent, indicated in sections of the Act, must be met. This, in part, requires considering regulations dealing with previous legislation, emphasizing the interdisciplinary approach and retaining flexibility in management decision making. Other rating criteria address the provision for public input and the ability of the process to provide for documentation. In effect, the documentation criterion suggests that the process must be logical and sequential so as to allow understanding of the sequence of events which led to certain decisions. The criteria also call for flexibility in the planning process to promote an acceptable range of alternatives. This allows for a possible range of alternatives from no or slight incremental change to an alternative plan with far reaching effects.

The planning process should define the flow of actions, decisions, and responsibilities. The process chosen must also be capable of being used. It must be compatible with the personnel and expertise available on forest staffs.

The process must be capable of defining long-term as well as short-term planning direction and actions. In effect, the process must provide variations in resolution. That is, users of the process must be able to define problems in low resolution or limited detail to consider long-term strategic solutions. At the other end of the spectrum users of the process must be able to define, in very high resolution or great detail, short-term programs for action.

In summary the conceptual planning framework must serve many purposes. The mixed scanning decision theory seems to best serve these needs. The theory lends itself to a planning outline and satisfies the "rating" criteria suggested above. The recommended conceptual planning framework based on mixed scanning decision theory is shown in Table 2.

The planning task is accomplished by proceeding through the diagrammed framework phases. While each of these phases is directed at a particular problem area, they are not completely exclusive of one another. The entire process should be developed and understood prior to embarking on the construction of a plan. With this in mind, the following discussion will proceed to elaborate on these phases with the aim of responding to the process criteria suggested earlier. The discussion will also serve to tie together the dimensions of planning, forms of planning organizations, role of the planning staff, and day-to-day management functions.

The initial phase is preplanning, or designing and preparing the organization for developing a plan. Each national forest is required by the NFMA regulations to form an interdisciplinary planning team (S 219.6), with the task of developing a land and resource management plan. The forest supervisor is charged with selecting individuals from various disciplinary areas to act as planning officers in a centralized planning

Table 2. Conceptual Planning Framework

<u>PLANNING PHASES</u>	<u>PURPOSE/TASK</u>	<u>TOOL/TECHNIQUE</u>	<u>RELATED NFMA REGS.</u>
<u>PREPLANNING</u>	-full development of planning process -review dimensions of problem -design organization for planning -designate planning team and management roles -designate functional groups -responsibilities -relation to other groups -channels of communication -allocation of manpower, equipment and materials	PERT CPM	S219.5(a)
<u>PROBLEM PERCEPTION AND IDENTIFICATION</u>	-sets need for planning action -initial identification of problems and issues -public issues, management concerns -influencing agency laws and regulations	DELBECQ DELPHT PUBLIC CODINVOLVE	S219.5(b)
<u>ESTABLISH GOALS AND POLICY</u>	-expression of basic direction, purpose and values -defines governing laws and regulations and limitations imposed on public forest management -establishes set of basic problems, resources, and values which will direct planning		30
<u>ESTABLISH PLANNING PREMISES</u>	-develops premises, assumptions and criteria to guide and evaluate planning -determines limits of influence of laws, policy regional planning targets and other agency programs -identifies factors pertinent to resource use, economic and social analysis criteria, and potential range of resource outputs		S219.5(c) (d) (e)
<u>ESTABLISH OBJECTIVES</u>	-establishes output target levels or ranges, conditions and states which satisfy goals -describes those factors and relationships which aided in determining objectives		

Table 2. Conceptual Planning Framework (continued)

<u>PLANNING PHASES</u>	<u>PURPOSE/TASK</u>	<u>TOOL/TECHNIQUE</u>	RELATED NFMA REGS.
<u>IDENTIFY ALTERNATIVE COURSES OF ACTION</u>	-defines management actions and associated output quantities and values -defines alternative sets of land and resource use constraints, budget limitations, and functions to construct different allocations -uses planning premises and objectives to build alternatives		S219.5(f)
<u>ANALYSIS AND EVALUATION OF ALTERNATIVES</u>	-estimates resource goods and services -estimates physical, biological, social and economic impacts -comparison of outputs and impacts to planning objectives -ranking of alternatives in accordance with ability to satisfy objectives and planning criteria	TIMBER RAM RAA MODEL 1,2 MUSYC FORPLAN INPUT-OUTPUT ANALYSIS SOCIAL IMPACT ASSESSMENT	S219.5(g) (h) 31
<u>SELECTION OF PREFERRED COURSE OF ACTION</u>	-obtain public review of selection -revise selection, if required, based on review -prepare and disseminate final selection		S219.5(i)
<u>FORMULATE PROJECT AND WORK PLANS FOR IMPLEMENTATION</u>	-develop alternative sets of programs or projects to implement plan -report expenses for all activities undertaken to implement plan	PAMARS ADVENT	S219.5(j)
<u>REVIEW AND FEEDBACK</u>	-comparison of program results with plan direction -comparison of program results with planning premises -evaluation and documentation of planning activities -alteration of planning direction or programs		S219.5(k)

staff. This step helps designate the "form of planning organization" discussed earlier.

Within this centralized body each functional area of the forest staff will have a representative who is responsible for communication concerning that part of the planning effort. This step then helps guide the flow of communication in the hierarchical structure of the organization. Through these channels the responsibilities and functions of each area are delineated and working relation to other areas established.

Once the planning problem has been defined for a particular national forest the supervisor and ID team can estimate the level of manpower, equipment and materials required by each functional area. If, for example, a particular forest cannot, by nature, supply a large timber industry, the timber planning staff may be small. Whereas, in the other regions the opposite may be the case.

The ID team must estimate the duration of each planning phase. Allocation and scheduling of manpower, etc. should be coordinated so as to efficiently use resources available during these phases. Tools such as the Critical Path Method (CPM) or Program Evaluation and Review Technique (PERT) may be used to help coordinate use of these resources over the time of the planning effort. Both methods can help minimize production bottlenecks, delays and interruptions by determining "critical" activities beforehand so components of the overall task can be well coordinated. These tools use networks to develop the logical sequence of activities which are undertaken to carry out the project. These networks exhibit the interrelationships of these activities over time.

Once the organization has been "organized" for planning, the ID team can proceed to problem perception and identification - developing an understanding of the problems and issues. In great part this relates to

broad issues and direction established at the national level in the RPA program. Regional plans consider these broad goals and introduce regionally defined resource production potentials, and regional public involvement. Target levels for resource use are then defined for each forest based on the individual forest's ability to supply goods and services. In this manner the linkage between national, regional, and forest level planning is established. However, if the supervisor upon evaluation of these objectives finds them, in part, incompatible with local supply and demand, economic efficiency, potential environmental effects, or other factors, he/she may negotiate their adjustment with the regional office (S219.13).

Problem perception also necessitates investigation of what the public perceives as the issues. This public involvement shows the Forest Service is responsive to the concerns of the public and that this public input is utilized in reaching decisions. Also, it is important that the public be acquainted with the planning activity and programs which the Forest Service is considering. This public input has sometimes been neglected, leading to misjudgments on the part of the Forest Service in providing for "meeting the needs of the American people," and misconceptions on the part of the public as to what the Forest Service is actually doing.

There are several basic problems planners must address concerning public involvement. For example, the planners must define the objectives for involving publics as well as who the relevant publics are. They must answer how publics should be involved and what information should be exchanged. Finally, the planners must select tools or techniques for public involvement and set their timing for incorporation into the planning process. To accomplish this the ID team can involve many different

groups - subject matter experts, interest groups, program analysts, plan builders, and decision makers. Interest groups may include conservation clubs, wood product industry, ranchers, and the general public. The ID team must develop strategies to involve all these groups. They must develop tools and techniques to "scan" in depth the field of publics as well as the range of their inputs. The ID team must provide a controlling function to ensure the tools and techniques are meeting the objectives for involving publics. Specific tools or techniques for accomplishing this are the Delbecq approach, Delphi, PUBLIC, and Codinvolve, all to be discussed in the next chapter.

It is important to realize that "scanning" for public sentiment is conducted not just in this problem perception phase but in each subsequent phase. For example, the problem perception phase and the identification of alternative courses of action phase require an exchange of dialogue between planning staff and public.

Once the scope of the problem is identified, the goals and policy of the forest with regard to the problem are stated. The goals and policy are defined by critical regulations and limitations for management based on federal law. These premises to planning include information of a factual nature and basic policies expected to be applicable in the future. Guidance from the MU-SY Act, NEPA, RPA and NFMA provide part of the information for constructing these premises. These basic premises or assumptions may be modified given some local influences concerning population, market prices, and political environment.

Objectives are specific targets for the planning effort. They suggest levels or amounts of resource use which approach meeting the goals specified. This requires a resource analysis to determine the capacity of

the forest to produce goods and services as well as the technical and environmental feasibility of producing these levels of goods (\$219.5e). Based on this resource analysis, the ID team proceeds to design different combinations of management actions and alternative courses of action which will satisfy the objectives.

As was stated earlier, it would be impossible for the ID team to, using rational decision theory, define all possible alternative combinations of resource uses and management intensity levels. Therefore, the team specifies a limited range of alternatives to meet the objectives. In doing this the planning team learns more about the problem's nature and scope.

This "identification of alternatives" phase brings in input from many sections of the forest organization including functional areas, program analysts, technicians, computer specialists, and others. All play a role requiring careful coordination by the ID team. All of these personnel inputs must be coordinated, directed in such a way as to maximize the use of personnel and equipment resources.

Analysis and evaluation of alternatives involves developing estimates of the output of goods and services as well as the associated physical, sociological and economic impacts. Without these estimates it would be impossible for the ID team to compare the alternatives in terms of meeting the goals and objectives. A number of tools or techniques may be used to conduct this analysis. These would include linear programming based tools such as Timber RAM, Resource Allocation Analysis (RAA), Model 1 and 2 formulations, Multiple Use Sustained Yield Calculation model (MUSYC) and the Forest Planning model (FORPLAN). Each of these tools or formulations use linear programming as a device for selecting between management activities which best meet the objectives while at the same time satisfying

other sets of limitations and requirements. Techniques such as input-output analysis and social impact assessment are used to examine the probable economic impacts of the plan.

Selection of the best course of action, the responsibility of the forest supervisor, is based on the results of the previous phase and public comment. Great care should be taken to fully document the analysis of alternatives and the process used to evaluate them. This is an extremely important ID team responsibility. They must show the evaluation criteria as well as a logical and sequential set of steps taken to arrive at a preferred alternative. This documentation and justification should appear in the Final Environmental Impact Statement (S219.11h).

Implementation of the plan requires developing alternative sets of programs or work plans. These will be directed at specifying and detailing the timing, location, and expenses associated with management activities which form portions of the overall plan. These alternative programs can be analyzed through a tool such as ADVENT. ADVENT is a linear programming based program budgeting tool. Another tool, PAMARS, is a computerized system for accounting for expenditures in plan implementation. Both of these tools aid in carrying out the management role of controlling. It is necessary to ensure that resources are appropriately and efficiently used and that work is progressing on time. The forest supervisor is responsible for ensuring that budgets and projects are in compliance with the plan (S219.5j).

Review and feedback, the last phase of the conceptual planning framework, is required to verify if program results are in line with direction established in the plan. Criteria and process to guide this review should be established as part of the plan (S219.5k).

This completes the discussion of the conceptual planning framework which attempts to present the theory on which it was formed, the purpose of the phases, and the roles of management in making it operational. The subsequent chapters will discuss these phases in detail with regard to the NFMA regulations and tools and techniques which may be employed to assist in completing each phase.

CHAPTER III

General Approaches and Analytical Techniques for Public Involvement in Forest Level Planning

The National Forest Management Act requires public participation in the development, review and revision of land management plans. What are basic problem areas in the realm of public involvement which planners face in development of management plans? Some are listed below.

- 1) What are the objectives of involving publics in natural resource planning and decision making?
- 2) Who are the relevant publics and in what manner should they be involved?
- 3) What kinds of information should be exchanged between planners and the public?
- 4) What techniques should be used to obtain public involvement?
- 5) When should public opinions be obtained with regard to different phases of the planning process?
- 6) How and in what form should information about resource management alternatives and other information be passed to the public?
- 7) How should public responses be analyzed and evaluated with regard to resource management alternatives?

As stated in the NFMA regulations public participation serves two vital purposes. First, participation provides the Forest Service with information regarding the needs and concerns of the public and, second, it allows the Forest Service an opportunity to voice and explain their programs (S219.7).

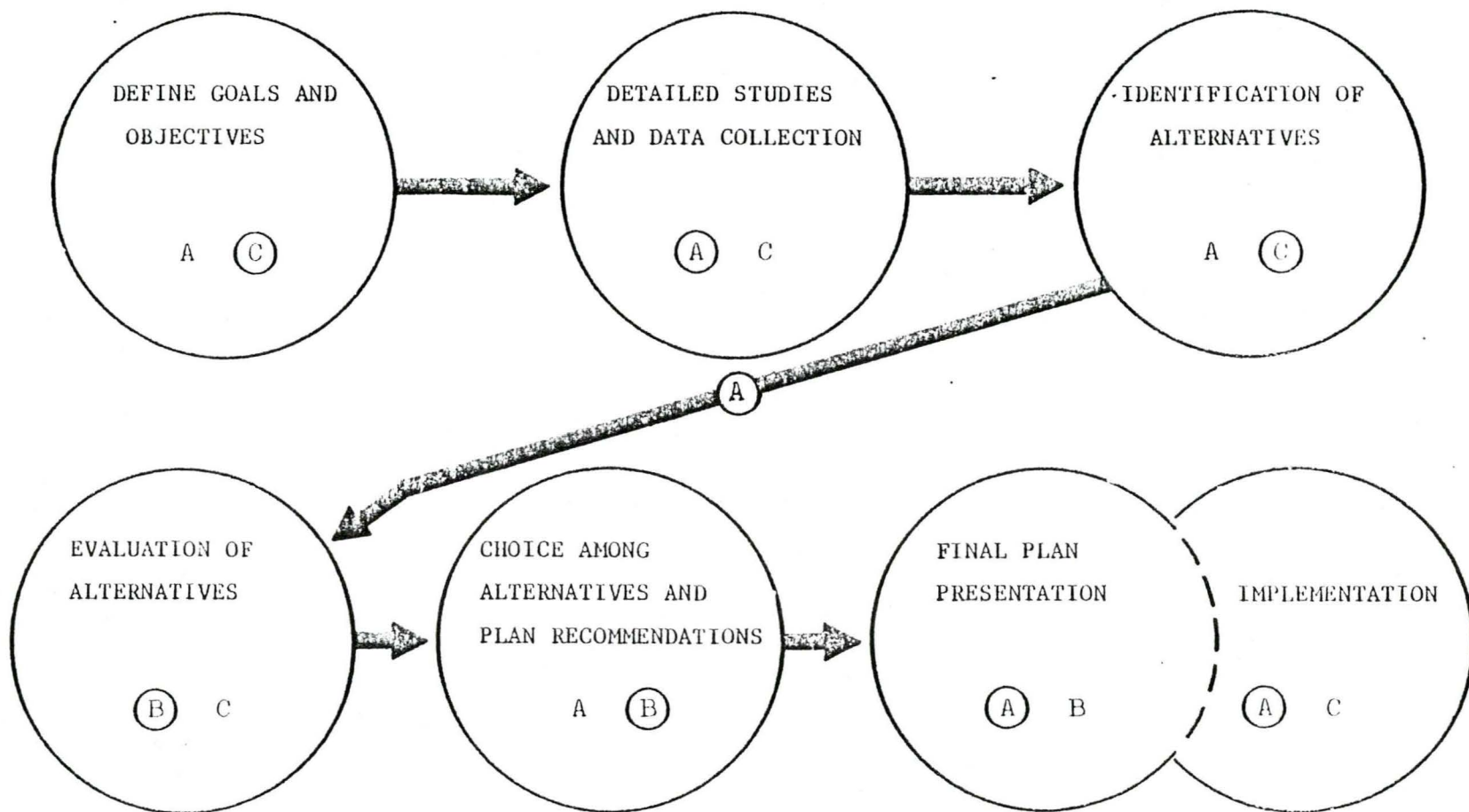
Information provided by public participation informs planners of what resources the public wants and where and when they want them. People living great distances from a national forest will probably hold differing values and needs as compared with those living within forest boundaries. Planners must consider these differences in deriving goals and objectives for planning. Often forest planning can provide means of settling conflicts between opposing sets of public desires. Conflicts may exist between forest-dependent lumbermen seeking a living and those individuals who travel many miles for vacation in the forest. To resolve these conflicts the planner requires public involvement information and a means of processing this information.

As shown in Figure 2, public participation or involvement serves several functions with respect to phases of the planning process. The ability to draw nice clean circles around these phases is only possible on paper. The phases are rarely, if ever, this discrete, and overlapping often occurs as each phase is dependent upon that preceeding it. The diagram defines by function the nature of public involvement with regard to each phase. These functions are (1) informational/educational, (2) reaction/response, and (3) interaction/dialogue.

Obviously procedures are required to carry out each of these functions. This chapter presents approaches and analytical techniques which provide support to one or more of these functions. An approach, as defined here, is primarily designed for informing publics and creating structured forums for exchange of ideas. Techniques, as used here, contain an analytical procedure designed to analyze and/or catalog public reaction and responses. A variety of data collection procedures may supplement the use of approaches and techniques. Input collecting procedures include public meetings, newsletters, individual

Figure 2. Orientation of Public Involvement in the Planning Process

[Circled code letters indicate the primary functional emphasis; additional letters indicate very important secondary functional orientation(s)]



Code for Flow Diagram Functional Orientations Designations

- A - Informational/Educational (Informing)
- B - Reaction/ Response (Feedback)
- C - Interaction/Dialogue (Informational Exchange)

(from "Public Participation in Water Resources Planning" - Katherine P. Warner)

contacts, questionnaires and others. While there is no single means of collecting public input it is generally recognized that using a variety of means is best. Because all interested publics are not able to attend or speak out in public meetings, or others willing to take the time to write personal letters, a package of different possibilities will help ensure each individual or group a means of participation. It should be apparent that all input collecting procedures have strengths and weaknesses. Table 3 indicates some of these.

The approaches and techniques used to fulfill the critical aspects of public involvement must be carefully selected. Clark and Stankey (1976) developed a set of six broad principles which any tool should meet and which the ID team should carefully review before a public involvement approach or analytical technique is used. These principles are shown in Table 4.

Procedures for the involvement of publics (approaches) and the quantitative analysis of public input(techniques) will now be discussed. The approaches include Delbecq or Nominal Group Process, and Delphi. The analysis techniques include PUBLIC and Codinvolve. Each utilizes a different approach and operational format but all are aimed at maximizing the utility of public involvement to help determine program goals and alternative strategies for management of resources.

The strengths and weaknesses associated with each technique/approach will be outlined in the context of the needs for forest level planning. This evaluation will be made considering the particular characteristics of using the techniques/approaches, how well they interface with other phases of the conceptual planning framework, and how well they satisfy the NFMA regulations. Finally, suggestions will be made for improving use of these methods in forest level planning.

Table 3. Means of Gathering Public Input

Communication Characteristics			Public Participation Techniques	Resource Planning Objectives					
Level of Public Contact Achieved	Ability to Handle Specific Interest	Degree of 2-Way Communication		Inform/Educate	Identify Problems/Values	Get Ideas/Solve Problems	Feedback	Evaluate	Resolve Conflict/Consensus
2	1	1	Public Hearings		X		X		
2	1	2	Public Meetings	X	X		X		
1	2	3	Informal Small Group Meetings	X	X	X	X	X	X
2	1	2	General Public Information Meetings	X					
1	2	2	Presentations to Community Organization	X	X		X		
1	3	3	Information Coordination Seminars	X			X		
1	2	1	Operating Field Offices		X	X	X	X	
1	3	3	Local Planning Visits		X		X	X	
1	3	1	Class Action Litigation	X		X	X		X
2	2	1	Information Brochures and Pamphlets	X					
1	3	3	Field Trips and Site Visits	X	X				
3	1	2	Public Displays	X		X	X		
2	1	2	Model Demonstration Projects	X			X	X	X
3	1	1	Material for Mass Media	X					
1	3	2	Response to Public Inquiries	X					
3	1	1	Press Releases Inviting Comments	X			X		
1	3	1	Letter Requests for Comments			X	X		
1	3	3	Workshops		X	X	X	X	X
1	3	3	Charettes			X		X	X
1	3	3	Advisory Committees		X	X	X	X	
1	3	3	Task Forces		X	X		X	
1	3	3	Employment of Community Residents		X	X			X
1	3	3	Community Interest Advocates			X		X	X
1	3	3	Ombudsman or Representative		X	X	X	X	X
1	3	1	A85 and A95 Review	X			X		
2	3	1	Environmental Impact Statement Review by Public	X			X	X	

1 - Low, 2 - Medium, 3 - High

CAPABILITIES OF PUBLIC PARTICIPATION TECHNIQUES

(From "Research Approach for Analysis of Public Participation Program" - Battelle Institute)

Table 4. Principles to Guide Selection of Public Involvement Tools

<u>Principle</u>	<u>Explanation</u>
Analysis is separate from evaluation.	Analysis is an objective replicable process; evaluation is subjective.
Decision making questions should guide analysis.	To make analysis most effective it is necessary to specify those questions in advance.
All input is relevant and must be processed.	Because all input expresses human values pertinent to the natural resources, all of it has implications for decision makers.
Analysis must be systematic, objective, visible and traceable.	Analysis should follow a structured procedure to check the way input is handled. It must be objective so independent review would generate the same information. It should be visible so the public can see how citizen opinion is used in making resource decisions. Finally, traceability assures that an independent reviewer can follow how the public input was handled.
Identity of the input must be maintained.	Decision makers later may wish to review how opinion varied according to the form in which it was expressed, the locations where it originated, etc.
Analysis must be a continuing process.	Because many resource management decisions evolve over extended periods of time, the analysis system must be capable of storing, retrieving, and summarizing information as needed.

(from, Analyzing Public Input to Resource Decision Making: Criteria, Principles, and Case Examples of the Codinvolve System, by Clark and Stankey, 1976.)

A. Delphi Approach

The Delphi approach is defined by Turoff(1970) as "a method for the systematic solicitation and collation of informed judgments on a particular topic". He further defines the application procedures as "a set of carefully designed sequential questionnaires interspersed with summarized information and opinion feedback derived from earlier responses". Delphi, then, is a procedure involving rounds of questionnaires, anonymous responses, feedback, and expert opinions directed at establishing a group consensus.

A major obstacle to using this approach by the Forest Service, or any federal agency, is that all questionnaires must be approved by the Office of Management and Budget. Delphi has been used for several purposes including its initial use for constructing military threat scenarios, long-range forecasting of technological developments, evaluation of development programs, and identification and prioritizing of policy and program issues (Turoff, 1970).

Basic steps in a Delphi exercise take the form outlined by Super (1970) shown in Table 5. The basic objectives are shown in Table 6.

A reoccurring problem for those using the Delphi approach relates to the announced intent of the exercise and the use of the final results. All too often the project team and the respondents find themselves viewing the process and the final results as the development of a decision. However, the consensus does not represent the simultaneous formation of a management decision. Instead, it provides a basis to support further analysis.

Table 5. Steps in a Delphi Exercise

<u>Step</u>	<u>Description</u>
1	a small monitor team is formed and designs a written questionnaire.
2	the first questionnaire consists of lead-in information focusing the respondents on the topic at hand.
3	the first round questionnaire would have each respondent give a ranked listing of as many natural resource problem (question) areas as possible.
4	the first round is followed by up to six additional rounds of questionnaires, each being made up of feedback from the ranked questions identified in the preceding round.
5	each preceding round's results are edited and consolidated into a listing of weighted group rankings.
6	in addition to the ranked questions, reasons for ranking each question are also solicited and returned with each new round.
7	upon receiving feedback from a preceding round, respondents are asked to re-evaluate their original list of ranked questions by adding or subtracting from it or changing their ranking.
8	each round of questions/feedback should produce changes in respondent's viewpoints since they will be operating on more information.
9	this form of feedback and re-evaluation continues for as many rounds as seems necessary to the monitor team, with the ultimate output approaching a group consensus listing of many ranked questions and reasons for those rankings.

(from, An Evaluation of Three Methods for Identifying and Ranking the Importance of Natural Resource Management Questions, by Gregory R. Super, 1977)

Table 6. Objectives of Using a Delphi Approach

	<u>Objective</u>
1	to determine or develop a range of possible alternatives.
2	to explore or expose underlying assumptions or information leading to differing judgments.
3	to seek out information which may generate a consensus of judgment on the part of the respondent group.
4	to correlate informed judgments on a topic spanning a wide range of disciplines.
5	to educate the respondent group as to the diverse and interrelated aspects of a topic.

(from, The Design of a Policy Delphi, by
Murray Turoff, 1970.)

Another misuse of the Delphi approach is to use it to try to develop support for organization viewpoint. If the project team attempts to use Delphi as a means of generating support for organizational values and opinions and the results do not support their viewpoints then the organization is put in the position of either not using the results or losing the commitment of the respondents.

The Delphi method can help meet the requirements for public participation as discussed in the regulations. First, Delphi can be used as a means of informing participants of the planning task and the critical issues surrounding the construction of the plan. It should, at the same time, broaden the information base with regard to public issues and concerns and the more subtle reasonings underlying them. The Delphi approach could be used in conjunction with one or several phases of the planning including issue identification, development of management alternatives and selection of preferred alternatives.

An important aspect of Delphi is the anonymity of the participants. Each participant, unknown to all others, is free to state his priorities or allegiance to a particular stance. In later rounds participants can freely alter their priorities reflecting the influence of information given to them from earlier rounds. If a unanimous conclusion is not reached by all participants a reasonable consensus can normally be established.

Evaluation of the Delphi Approach

The "hardware" requirements of Delphi pertain to the number of respondents or participants in the process. It has been suggested (Super, 1977) that 50 respondents is the maximum number which could be handled by an analysis done by hand by an analysis. Larger numbers could

be handled if computer facilities are available. Because the process is a non face-to-face approach no facilities are required other than staff operations space. Personnel requirements depend, in part, on the number of respondents involved, the size of the problem area and the number of rounds. Due to the number of rounds involved and the time necessary for participants to respond, the Delphi operation normally does not require a full time staffing.

Time spent by respondents, like that of the project staff, is confined to relatively short periods. However, as additional rounds produce further information, more review time is required of the respondents. Because of this the project staff must be careful to select enthusiastic, interested respondents.

Most Delphi projects entail from two or six rounds of questions which normally require a total of four to twelve months to complete. This long duration may place a burden on the respondents and pose problems in maintaining continuity and enthusiasm. Therefore, each round's question set should be designed to take no longer than an hour to complete.

The scope of information received from a Delphi approach is directly dependent on the initial problem set sent to respondents. If the initial problem is broadly stated, the Delphi will produce general results. On the other hand a Delphi exercise, restricted to a more specific topic area, will produce far greater detail in responses given by participants. Typically the exercise begins on a fairly broad scope and then proceeds through successive rounds, to a more highly specified and detailed format. General questions, developed for early rounds, are broken down into sub-questions to eventually develop highly refined statements concerning what the set of

goal/actions should be. They can also be used to identify significant types of data and criteria which should be used to develop alternatives/goals.

The primary benefit of Delphi is its reliance on the individual confidential format for involving participants. This format avoids travel costs, group interaction problems, and can be, if properly monitored, used to elicit highly specific information of direct utility to planners.

With regard to the regulations Delphi may help satisfy many of the requirements as suggested earlier. However, since the approach generally involves a rather small public group, it should be used with other involvement tools. The approach usually covers a time span of many months, perhaps a year, and therefore normally limits its use to a single phase of the planning process, like issue identification. This time requirement would make it necessary to decide early in preplanning whether such an approach will be used. If systematically managed, the Delphi approach can serve as a bases for documenting the development of a final consensus.

Use of the Delphi approach on a national forest can be enhanced by an indepth training session for those involved. ID team members can develop an initial set of questions. A short one round exercise with selected staff members may help point out problem areas before approaching outside participants. Finally, personal communication with perspective respondents may help ensure their interest and dedication throughout the rounds.

B. Delbecq Approach or Nominal Group Process

The Delbecq approach or nominal group process can be used in all phases of the planning process. Delbecq is a process designed to solicit maximum, direct participation of individuals in program development. It is a group-oriented process which can be used to help identify strategic problems and aid in structuring innovative solutions. Delbecq is designed to inform interested individuals and organizations of the role and operation of the organization. It also is unique, in comparison to other tools, in that it promotes participation in planning phases from issue development to evaluation of final alternatives. This type participation is called for in the regulations which require frequent public input throughout the planning process, including the development, revision, monitoring and evaluation of plans.

According to Delbecq and Van de Ven (1977), the Delbecq approach is conducted through the phases outlined in Table 7 which readily interface with the planning sequence presented in S219.5, Regional and Forest Planning Process, of the regulations.

Phase 1 is initiated by selecting public participants who are consumers of the products or services in question. A meeting is held involving approximately sixty people to explore the issues surrounding the problem. This restricted involvement normally necessitates that other public participation tools be also used to ensure all publics take part. The purpose of this initial meeting is to discuss problems only and not specifying ideas for solutions. An outline of the Phase 1 meeting is shown in Figure 3.

Table 7. Phases in the Delbecq Approach and Personnel Participation

<u>Phase</u>	<u>Description</u>
1	Problem Exploration - involvement of client or consumer groups. - involvement of first line supervisors.
2	Knowledge Exploration - involvement of internal scientific personnel. - involvement of internal and external organizational specialists.
3	Priority Development - involvement of resource controllers. - involvement of key administrators.
4	Program Development - involvement of line administrators. - involvement of technical specialists.
5	Program Evaluation - involvement of client or consumer group. - involvement of staff and administrative personnel*

*client or consumer group representatives are participants in every phase except Program Development.

(from, A Group Process Model for Problem Identification and Program Planning, by Delbecq and Van de Ven, 1971.)

The Phase 1 participants are split into small groups whose members privately record their individual problems and arguments from a personal as well as an organizational perspective. An organization staff member works with each group and asks each individual to cite one problem. After all members have stated their problems, they are recorded so all group members can review the problem list. The next step involves an open discussion of these problems to facilitate group understanding of each problem statement. Finally, each group member privately votes on those problems he/she feels are most significant. These votes are then tabulated for the entire group. All groups are rejoined for an overall discussion of the problems.

This small group process with controlled interaction is an attempt to promote a broader discussion of problem dimensions and higher quality comments. This controlled interaction attempts to lessen inhibitions of individuals which may occur in a general public meeting so that each will discuss problems personally relevant and not just those he can fully justify or feels comfortable in presenting. Small group interaction also tends to focus thought in a particular direction.

The process also promotes dialogue between the public and the professionals. The process begins by focusing on the participant needs so that the driving force behind program development is seen to be public concerns rather than the goals of the organization's members. The process attempts to put each participant on equal footing with the professionals. The procedure specified for phase 1 is easily organized, minimizes the personal involvement time of participants, and quickly provides a base for orienting planning staffs to what the public perceives to be the real problems at hand.

The second phase of the Delbecq approach attempts to define solutions to problems. This requires the involvement of scientific experts, external and internal to the organization whose expertise relate to the priority problem areas specified in phase 1. A meeting of these experts along with selected phase 1 representatives is held to construct a qualitative description of the problems.

In phase 2 the participants are again separated into groups in this case comprised of a cross-section of scientific disciplines and organization affiliation. Each group member is asked to write personal solutions to the priority problem list established in phase 1. The group discusses the solution possibilities and attempts to determine the most reasonable combination of solutions to each problem. All groups then report their recommendations to the entire body. The meeting closes with a vote by all on the solution possibilities they feel are best.

Phase 2 is useful in the 'formation of alternatives' step of the regulations. It redefines the problems from phase 1 and outlines solutions incorporating public, scientific and organizational input. The process also involves, at an early planning stage, various scientific and functional backgrounds and promotes creative thinking on the part of these individuals.

Phase 3 involves key decision makers who would be responsible for implementing any of the proposed solutions and control the resources to develop those solutions. This phase parallels the 'identification of management concerns' and the 'analysis of the management situation'; (S219.5 b,e). Phase 3 seeks the input of line managers and administrators regarding the problems and proposed solutions and possible adjustments required to make them operational or feasible.

Figure 3. Outline of Phase 1 for Delbecq

Outline of Phase I Meeting

- I. Selection of Client or Consumer Sample
(Divided according to age, geography, technical application, or other appropriate categories)
- II. Meeting with Clients or Consumer Groups to explore problem dimensions
 - A. Introduction (10 minutes)
 1. Welcome
 2. Expression of organization(s)' interest in clients' problems
 3. Indication that focus is on problems, not solutions
 4. Explanation of "personal" vs. "organizational" problems
 - B. Directions for small-group participation
 1. Assign clients to small groups of 6 to 9
 2. Instruct them in nominal group format
 - a. Listing "personal" problem dimensions on 5" x 7" cards (15 minutes)
 - b. Listing "organizational" problem dimensions on 5" x 7" cards (15 minutes)
 3. Provide flip chart and recorder for round-robin sharing of individually noted items
 - a. Items from individual cards (first organizational, then personal)
 - b. New items suggested by process
 - C. Fifteen-minute break
 - D. Interacting group discussion of each item on flip chart in serial fashion for clarification, elaboration, and/or defense, but not for collapsing or condensing items.
 - E. Nominal group voting on 3" x 5" cards for top five priority items on both "personal" and "organizational" lists
 - F. General Session—discussion of tabulated votes from each small group
 - G. Explanation of PPM and election of representative(s) for Phase II

(from "A Group Process Model for Program Identification and Program Planning", Delbecq and Van de Ven)

Phase 4 conforms specifically to the 'formation of alternatives' and the 'estimated effects of alternatives' as they appear in the regulations; (S219.5 f,g). It refines the alternative proposal, given possible modifications from phase 3, into a final, explicit, program proposal. It combines the input from the three previous phases and develops a program which can be supported by the results of the previous phases. The approach therefore attempts to construct alternatives that have scientific merit and public acceptability.

The last phase, Phase 5, unites participants from all the prior phases to evaluate ('evaluation of alternatives') the final program plan. A meeting is held to re-acquaint those involved in previous phases with the process and issues. This review will also indicate the compromises that may have been developed along the way. At this phase it is important to show a clear link between the final plan and the concerns established in each phase.

Delbecq or the nominal group process has been widely used within the Forest Service and the Bureau of Land Management in one form or another in the planning process. It has been used, in particular, to define public issues at the initiation of a planning effort.

Evaluation of Delbecq

Delbecq provides a process outline which appears to interface quite easily with the conceptual framework discussed in the previous segment of this report. It is designed to maximize the quality of participation at various stages of planning and provides a means for face-to-face participation of the critical agents in program planning.

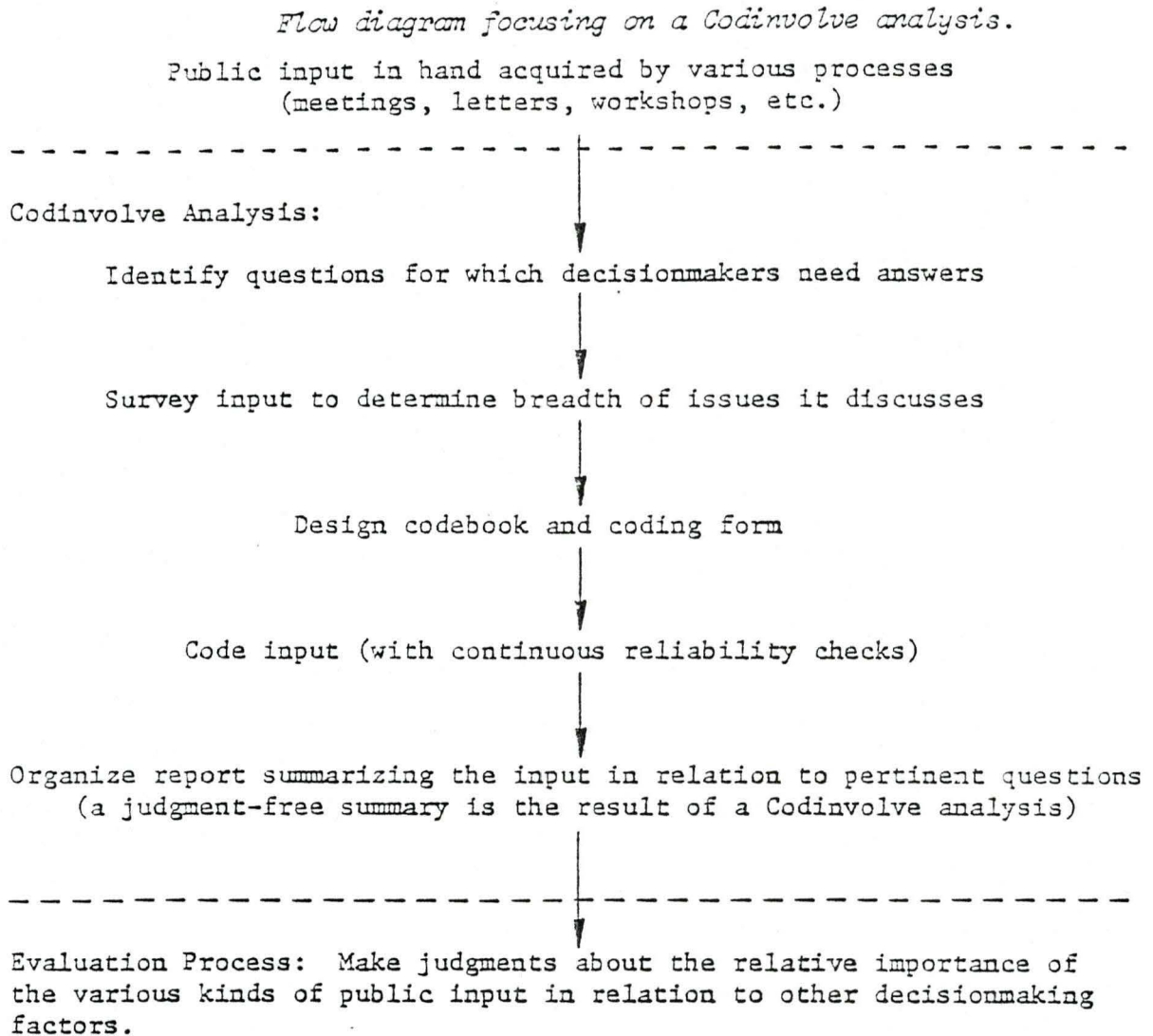
Phase 1 of Delbecq is easily organized, requires a few personnel, and minimizes the time requirements of the participants. The process can be coordinated with pre-planned steps and thus requires little additional personnel or expense. The cross-sectional group of participants help ensure the problems and solution possibilities are considered in detail.

Delbecq satisfies many of the regulation sections pertaining to the use of public participation (S219.5 b, S219.7). It provides a mechanism to involve a public group in all the phases of planning. In the process both the Forest Service project team and the involved publics can become highly attuned to one another's goals and concerns for management. However, Delbecq is limited to only a small public group necessitating that other measures also be used to involve publics which may have been left out. Careful recording of inputs at various planning stages allows public involvement to be documented to help justify positions. The use of Delbecq requires considerable pre-planning on the part of the project team to make certain schedules for participants are set well ahead of time.

C. Codinvolve - An Analysis Technique

Codinvolve is a public input analysis technique. It was developed in 1972 to address problems of public involvement encountered by the U S Forest Service. The Codinvolve technique is designed to store, retrieve, summarize and display quantitative information concerning public inputs as well as the qualitative bases for these inputs. Given the variety of public involvement (letters, petitions, response forms, etc.) Codinvolve allows planners a "systematic, objective, and traceable means of handling input" (Clark and Stankey, 1976).

Figure 4. Codinvolve Flow Diagram



(from "An Introduction to Codinvolve: A System for Analyzing, Storing
and Retrieving Public Inputs to Resource Decisions", Clark, Stankey,
and Hendee)

The Codinvolve system is used after the determination and employment of public input collection procedures. That is, it is an analysis technique not an approach to developing public involvement. Codinvolve can be used to scan the input (via Delphi, Delbecq approaches) for opinions and the supporting logic for these opinions. This information can be then stored, summarized, and displayed.

It should be emphasized that Codinvolve is not a computer program per se but is an analysis process which can be accomplished through the use of edge-punch, card sorting procedures as well as the computer.

Figure 4 illustrates the basic Codinvolve analysis.

Technical and clerical staff are usually employed as input coders. This limits costs and generally yields high accuracy. It is not necessary, and perhaps sometimes not preferred, to have professional people knowledgeable about the issues performing this function. Indeed, past applications have shown some bias in coding by highly issue-knowledgeable people. Training of coders normally requires three to four days. The amount of input the coders can handle varies with the type of input as well as individual abilities. For example, complex letter form material can take considerable time whereas very structured response forms can be processed quickly.

Codinvolve has been used in over 30 resource management studies. Four studies which illustrate its flexibility include: the use of DDT to battle the Douglas fir tussock moth, development of a winter sports area in Oregon, a review of a wild and scenic river proposal and wilderness area study, and the Roadless Area Review and Evaluation (RARE I).

The DDT study involved writing an EIS and was directed primarily at the question of using DDT to control the tussock moth. Codinvolve was used to analyze public input concerning this single, local issue.

The winter sports facility, the Pelican Butte development near Klamath Falls, Oregon, was again a single use, primarily local issue confronting the staff of the Winema National Forest. Codinvolve was used to analyze public input concerning the suitability and impacts of the proposed development. In this case some of the public response actually pertained to management problems far broader than just the facility. The Codinvolve technique was able to detect this as this input was categorized. The Codinvolve technique was used to display results to help allay public doubts over the use of their input by the Forest Service.

The third case involved the wild and scenic river proposal and wilderness proposals in Idaho (Salmon River, Idaho Primitive Area, and Salmon River Breaks Primitive Area). Here a wide range of alternative land uses were in question provoking a complex set of questions and many responses. The total Codinvolve analysis involved nearly 7,000 inputs and took six weeks to complete. Several diverse collection methods were used. Due to this diversity, "non-additive" responses were obtained creating analysis and evaluation problems. Careful identity of the inputs had to be maintained to help ensure correct analysis and interpretation.

The 1972 RARE study focused on potential wilderness areas throughout the United States. Codinvolve was used to survey public reaction to the draft Environmental Impact Statement (EIS). The great diversity, complexity and number of issues required computer storage and tabulations.

In using Codinvolve the type of input the staff encourages should be well thought out to match later coding and analysis. Unstructured responses such as letters may require more time and care to code while at the same time structured responses alone may constrain the development of scope and detail. A mix of inputs generally help ensure that issues are covered adequately.

Where the amount of inputs is not too large, Codinvolve's edge-punch card sorting technique may be used. This technique is relatively easy to use and efficient. Where a large number of inputs is to be analyzed by the computer, using a program CODE can provide a savings in time and money. The program duplicates the card sorting process but can perform a great many summary tabulations more efficiently than if done by hand.

The analysis and display of tabulations conforms with regulation requirements for evaluation and documentation of public concerns. Codinvolve can be used to assist in meeting the requirements of any of the planning phases from ascertaining public perception of issues to evaluating public reaction to the impacts of possible alternatives. Codinvolve provides tabulations of input in a form readily understandable to the public.

Evaluation of the Codinvolve Analysis Technique

Codinvolve can be used to store, retrieve, summarize and display information from public inputs in both quantitative and qualitative form. Codinvolve is particularly attractive because it can "process" information from a variety of public input collection procedures. Codinvolve can also be used to compare a larger "sample" of public inputs to those derived in a more "limited input" Delbecq type approach. For example, Codinvolve tabulations of public issues and concerns could be introduced into Phase 1 of Delbecq helping to bring attention to areas which may not have initially been addressed by participants. Codinvolve may prove useful in ensuring early and frequent consideration of public impacts in decision making, especially where there are great numbers of and complex issues. Rigorously performed, Codinvolve can help satisfy NFMA regulations pertaining to the analysis and documentation of public comments on issues (5219.7d,e,f).

D. PUBLIC - An Analysis Technique

PUBLIC is "a collection of quantitative procedures designed primarily for use by public agencies who are attempting to heighten and improve the public input in the decision-making process" (Case, et al.). The Forest Service has used it to help outline land management goals and to formulate alternatives.

Using PUBLIC requires that planners select a representative cross-section of local citizens. Initially the entire group is asked to rank a list of preferred resource uses. These individually ranked lists are 'run' through the PUBLIC computer program to identify the overall group use preference ranking. The program segment 'FACTOR' analyzes these individual responses to develop subgroups of participants who express similar preferences among their lists. The agreement within the subgroups is expressed on a '0' to '1' scale by the Kendal Concordance Coefficient with '1' representing total subgroup agreement and '0' representing an absolute lack of agreement. The assumption made here is that the diverse interests represented by the subgroups will adequately represent sectors of the community. An assumption is also made that groups made up of individuals with similar preferences and biases will work together more efficiently than those with highly diverse preferences.

The subgroups are then supplied with specific data and information about the planning area. The program segment 'ORDER' provides each subgroup with a ranked listing of key issues most closely representing the issue ordering most acceptable to all members. With this information each subgroup works with a resource specialist to develop resource output targets. Each subgroup is also asked to suggest what management procedures should be used to reach these targets.

This information provides the Forest Service planning staff with a wide range of alternative management programs and output targets mixes which can serve as a portion of the basis for development of management goals and alternatives. It conforms to the requirements set forth in S219.7(a)1-5 of the regulations.

PUBLIC can also be used to examine the compatibility of forest planning staff activities to that of the community. In certain cases this has shown differences between preferences held by the staff and those of the public.

In the past PUBLIC has been widely used in Regions 1, 2, 4, and 10 to structure working groups to aid in developing unit plans.

Evaluation of PUBLIC

It has been suggested that PUBLIC has received limited use due to the statistical and computer expertise required to operate it. Sometimes those individuals charged with public involvement input lack the analytical skills required to use the technique. Problems may also arise in the selection and commitment of participants since they must participate for a full day in an unfamiliar situation. It may also be a problem to select a cross section of individuals that are truly representative of community values.

The costs of conducting a PUBLIC session are generally low as most of the work can be accomplished in one day by the existing staff. However, it is necessary to make arrangements for a suitable facility for the session, possibly bring in outside expertise to work with the PUBLIC program and to obtain computer access. Participant travel costs are generally kept to a minimum assuming the population sample is confined to the immediate area.

It is generally best to limit the application of PUBLIC to problems of limited scope. The time constraint of a one-day session does not permit a concentrated effort on a wide range of topics where each topic requires a fairly detailed response from subgroups. It is possible, though, to conduct several PUBLIC sessions to increase the scope of the analysis. In general, the quality of the output from the sessions depends on the number of participants, their effort and enthusiasm, and the thoroughness of direction provided by the project team.

The first phase of the Delbecq approach relies heavily on interpersonal relations between individual subgroup members and their ability to reach a consensus. PUBLIC could be used in this phase to separate participants into like-minded subgroups to minimize individual conflicts and improve their ability to reach a consensus.

PUBLIC, used in the manner described above, does not meet all the requirements of public participation outlined in the regulations since only a portion of the interested publics is involved. Other public involvement procedures would be required to ensure all have a means of participation. However, it is important to realize the PUBLIC analysis technique could be used via any collection means. It is not limited to group sessions. However, this type input collection does avoid the OMB questionnaire approval problem and the Federal Privacy Act requirements.

E. Conclusions

Each of the approaches - Delphi, Delbecq, and techniques - Codinvolve and PUBLIC, has the potential to be integrated with the management/planning framework and serve the functions of helping to identify issues and concerns as well as alternatives the public feel are appropriate. While each of these tools offers a somewhat different approach to gathering and

analyzing public input, they can all be used to develop a general, if not quite specific, information set for public managers to scrutinize.

At the outset of this chapter the question concerning the purpose of public participation in resource management was posed. Basically, the suggestion was made that the management of the public domain should be directed at meeting the needs and demands of the American people. The National Forest Management Act regulations specify, in limited detail, just how this knowledge of public desires for management is to be gathered, including how and when the public is to become involved in the forest planning sequence. Indeed, S219.5(b) and S219.7 aim to ensure that three basic features involving frequent public participation are incorporated in the planning process in order to increase the public's understanding of Forest Service planning and programs, and ensure the Forest Service recognizes and understands public desires.

The Delbecq approach seems to meet the functional requirements of the planning outline and does provide a format with which other tools may be used. Combining Delbecq with other tools discussed earlier seems to be the best approach for the Forest Service. Delbecq is unique in that it structures the face-to-face interaction of the public and the Forest Service staff at each planning step. Representatives at the first Delbecq step, problem exploration, are involved through each subsequent step interacting with staff members to the final evaluation of alternatives phase. Delbecq then appears to satisfy S219.7(c) which calls for early and frequent public participation throughout the process. It allows participants to actively observe and contribute to every step, increasing their understanding of Forest Service management and planning opportunities, problems, and techniques. The more standard, general public meetings which

a forest may hold do not seem to have nearly this potential for developing useful, quality input from individuals. Further, the Delbecq approach, through its direct public interactions, can make apparent the need for additional public input, and in doing so, may point out the requirement for use of supplemental public involvement tools. This free flow of information between the public and professionals can help the Forest Service to design better public involvement procedures. Therefore, Delbecq is recommended as the fundamental approach to public involvement combined with specific techniques to help analyze this input.

Codinvolve is basically an information system. It can be utilized to code all forms of public inputs for analysis. Codinvolve accomplishes this analysis through grouping by issue and summarization of inputs into various tabular forms indicating the relative support and breadth of views on issues. Codinvolve can be used with a Delbecq approach to provide analysis of the small group input as well as public input derived from other means. Together, the Delbecq approach and Codinvolve technique provide the total planning process with an involvement approach and information and analysis system. Through the use of such a combination, the planning staff can be fairly well assured of satisfying regulation requirements.

Delphi may also be considered to focus indepth public attention on issue identification and the analysis of alternatives. However, Delphi does require a substantial length of time and dedicated participants to ensure its success. PUBLIC provides a systematic means for developing participatory groups holding similar views. It could be a useful tool as part of the Delphi or Delbecq approach to subgroup individuals and rank alternative priorities.

It should be apparent that all these approaches/techniques address the task of public participation from different angles and none alone meets the NFMA regulations governing public participation. However, in this discussion Delbecq and Codinvolve, or similar tools, seem to be appropriate to satisfy the basic public participation needs of a planning team. Other tools such as PUBLIC and Delphi have the potential to further resolve issues and alternatives for management and may be appropriate or even necessary in certain situations. However, they do require special technical expertise or time requirements which necessitate special attention in using them in the process.

CHAPTER IV

DEVELOPMENT AND ALLOCATION ANALYSIS OF ALTERNATIVE FOREST MANAGEMENT PLANS

A. Introduction

The NFMA regulations require that the forest interdisciplinary team develop estimates of physical, biological, economic and social effects of plans. Essentially this step is aimed at estimating the effects of each alternative plan and the tradeoffs possible within and between alternatives. The forest plan is to respond to issues identified through public involvement, regional RPA input and management concerns. In essence, these issues lead to specific forest goals and objectives, as outlined in the conceptual planning framework, for the development of a forest level plan. The various alternatives typically are based on different sets of these objective targets (ranges of resource outputs and forest conditions).

The selection of one alternative from this group is based on the decision criteria. These criteria are broadly outlined in the regulations (S219.5c) and are to be further specified by the ID team. These criteria should consider regional plan objectives, public/management concern input, and resource development opportunities. Other important ecological, technical, and economic factors are also to be actively considered. These criteria will help establish measures for judging the appropriateness of alternative plans.

The development of an alternative requires, in part, the systematic collection of data which help to define the resource system, responses of the system to management activities, and the costs and benefits associated with the activities. As discussed in "Land Management Planning - Analytical Aids," (Betters, 1977), the development of alternatives requires a series

of basic steps. The first step, defining the resource system, is directed at developing a description of the land area itself, and identifying resource and product outputs. Given this, management actions can be specified to provide these type outputs.

Defining the resource system requires the land area to be classified into units (called ecological land units, capability areas, resource allocation units, or response units) which make resource information available in a systematic form. In classifying areas consideration should be given to ecological as well as socio-economic features and issues/concerns identified earlier in the planning framework. This identification can be used to help identify management actions which are suitable to specific units.

The next step is to define resource responses to management actions over time. This task requires data and professional expertise to determine the probable resource outputs as well as economic values associated with management actions. Assuming a plan is developed for a series of years, a management action may result in differing resource response levels over those years. For example, timber harvest may cause a dramatic initial change from the present situation in sediment yields. However, as vegetation reclaims the site, sediment quantities will approach a more stable level. This change in response levels should be considered as they occur over the planning period.

Having defined the resource system and responses to management actions, various procedures can be used to determine what management actions (for each alternative) might be applied when and where to provide a certain level of goods and services. A discussion of these procedures is the topic of this chapter. The tools to be discussed are based on

linear programming. Linear programming is an allocation model which can be used to help schedule activities through time. Given an objective, such as maximizing resource outputs or net benefits to society, linear programming can be used to select those activities which best meet the objectives while at the same time satisfying a number of other requirements specified for an alternative. The objective function has weights or values for the selected activities so that their contribution to, for example, maximizing returns, can be measured and summed. The activities representing the variables in the model can include made many different silvicultural prescriptions, building facilities, construction of recreation areas and so on. The requirements force the model to provide at least a certain amount of various outputs, and the limitations constrain certain resources, such as the budget, and acres available for certain uses.

Specific linear programming models to be discussed include Timber RAM, Resource Allocation Analysis, Model I and II, MUSYC and FORPLAN.

B. NFMA Regulations Pertaining to the Development of Alternative Forest Management Plans

In the development of a forest plan planners are responsible for devising a range of alternative plans for meeting desired levels of goods and services from limited forest resources. For each alternative, planners must "determine resource management practices, harvesting levels and procedures under the principles of multiple use and sustained yield and the availability and suitability of lands for resource management," (S219.1b). In constructing alternative plans the regulations require following basic principles concerning the management of natural resources. For example, plans must consider the relative values of renewable resources

including the "values" of non-market goods and services. Plans must protect and improve where possible, the sustained yield of products and services from the forest. Further, plans must be developed in accordance with a systematic, interdisciplinary approach to ensure integrated resource plans. Planners must consider changing land and resource conditions, and economic efficiency in the development of alternatives. These factors and others serve to guide construction or selection of a tool to help structure alternative plans.

The basis for development of forest plans is presented in S219.5 of the regulations. The regulations specify a set of factors to be used as inputs for developing planning criteria. These factors emphasize the consideration of law and policy, national and regional goals, public issues, management concerns, and resource use and development opportunities. Forthcoming guidelines for standardizing factors related to economic analysis will also assist in the development of criteria to guide the planning process.

A range of management possibilities, or intensity levels, is to be specified through analysis of the resource system. These intensity levels must consider the targets identified in planning goals (S219.5e). In conjunction with evaluating each intensity level, economic analyses must be conducted to determine levels of goods and services which maximize net public benefits, (S219.5e). Linear programming meets this requirement by maximizing present net worth (PNW), if PNW is reflective of net public benefits.

The analysis of each alternative requires land stratification, resource information collection, identification of feasible management actions and resulting output levels over time. The regulations, (S219.12), give

some guidance regarding these items, particularly where timber is a viable output. Land stratification is to proceed by developing categories of land with similar management costs and returns. The critical characteristics of a land classification scheme are listed below. A land classification scheme should be: useful to many types of analyses, durable, hierarchical and provide information for many levels of planning, observable in the field to aid ease of application, adaptable to available data, and able to be coordinated with other analysis systems.

Presently the US Forest Service is working with the other agencies in standardizing a classification system. This new classification work is of particular importance given the regulations concerning timber management. According to the regulations (S219.12), those lands suitable for timber management, as defined, will be stratified to reflect similar management costs and returns. This stratification should consider physical and biological site conditions and the transportation scheme. This stratification and information gathering is highly oriented to timber growth and financial returns over time. In an integrated plan other multiple uses must also be explicitly considered. Regulation citation S219.9 emphasizes explicit consideration be given to the costs and production of wilderness, diversity of plant and animal communities, fish and wildlife habitat, range, recreation, minerals and cultural resources. The classification scheme needs to be useful for planning in these areas also.

Finally, the tool used to assist in the analysis of alternative must, where practicable, represent "the most cost efficient combination of management practices examined that can meet the objective established in the alternative." This requires an analysis tool to select management actions which satisfy desired levels of goods and services and minimizes the ex-

penditures involved in those actions. The tool, then, must produce formulations which specify outputs as well as their timing and flow of benefits and costs, (\$219.5f).

As was stated at the outset of this section Timber RAM, Resource Allocation Analysis, Model I and II, MUSYC and FORPLAN will be discussed as tools useful in the analysis of alternative plans. All of these tools are based on linear programming which develops efficient allocations of resources among competing uses over a period of time. The approach can help meet the economic efficiency aspects while also considering the joint production relationships, environmental protection needs, and the scientific adequacy specified in the regulations.

C. Resource Allocation Analysis

Resource Allocation Analysis (RAA) was developed by the US Forest Service to aid managers at the forest level in analyzing and evaluating alternatives (SAU-LMP). RAA consists of three basic components; data generation, allocation analysis, and allocation display. The system requires the specification of goals and objectives as well as a range of desired target levels aimed at responding to the critical issues identified by the forest planning team.

Data generation necessitates establishment of per acre "commodity" outputs for each management activity. The level of commodity output must also be specified for each time period. The computer program which generates the data for the linear program matrix is called MAGE 5. This matrix is then used as a portion of the linear programming model. MAGE 5 calculates average response figures for various commodities. This data generation is, by far, the most time consuming element for the user.

The allocation analysis portion of this package is the linear program. It can utilize the same matrix repeatedly, for analyzing different combinations of output requirements, objectives, and management considerations.

The display programs are designed to use the solution output file of the linear program (LP) and the matrix data file from MAGE 5 to display various types of summary information in tabular form.

A simple example will be used to illustrate the RAA approach. It is first necessary to classify the forest into land segments where delineation is based, in part, on productive capability. These management land areas, analysis areas (AA's) are assumed to generate similar per acre responses, given a management action. The next step is to outline desired commodity outputs based on the objectives defined. How well a forest management alternative meets various commodity needs helps serve as a criterion for choosing among alternatives.

The table below illustrates the typical RAA format. The commodities in this example (A,B,C) are wood output, recreation use, and wildlife numbers.

		Alternative #1			
Commodity	AA#1	Management Actions			Desired Outputs
		X	Y	Z	
	A	A1	A2	A3	Ad
	B	B1	B2	B3	Bd
	C	C1	C2	C3	Cd
Response Matrix					

where: A1 is the MBF of wood which would result if one unit of management action X was used on Analysis Area #1

B2 is the number of recreation visitor days which would result if one unit of management action Y was used on Analysis Area #1

C3 is the population of elk which would result if one unit of management action Z was used on Analysis Area #1.

Ad is the desired wood output level

Bd is the recreation visitor days desired

Cd is the elk population desired

Each management action, if implemented, produces a certain level of commodity output response. For example, if a clearcut timber management action was applied some amount of wood would be harvested, as well as a certain amount of wildlife and water runoff. These commodity outputs would probably differ when compared to other activities such as "no action" management action. The A2 entry, for example, would represent the amount of commodity A produced due to implementation of one unit of management action Y. This same explanation could be repeated for all commodities and all management actions in the AA to form that AA's "response matrix." This would then need to be repeated for all other AA units on the forest. All commodity demands (Ad, Bd, Cd) would also need to be quantified.

In the RAA system the linear program technique is used to determine the mix of management actions which should be chosen in order to meet the desired outputs while at the same time maximizing or minimizing the objective function. The desired output demands are normally expressed in "greater than" terms.

Given AA#1, after the optimal allocation, the amount of commodity A produced would be $A1X^* + A2Y^* + A3Z^*$ where X^* , Y^* , Z^* are the optimal allocations for management actions X, Y and Z respectively. Of course, the actions chosen may not be the same for each AA. The sum of all management actions represents one management alternative allocation.

In similar fashion the process described above could be used to analyze other management alternatives. Here different sets of commodity output targets may be specified and the linear program would then create new land

allocations, given the efficiency objective. These results can be used to compare a set of alternatives. The following example illustrates how allocations may change by alternative.

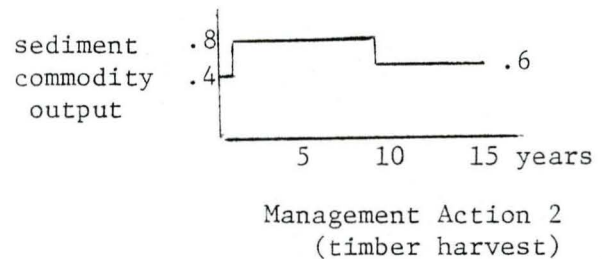
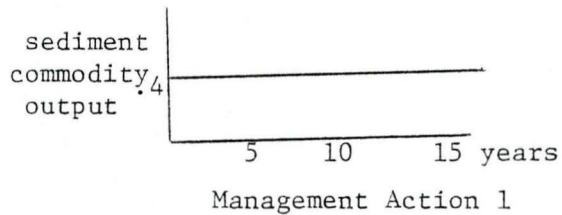
AA	Management			Acres allocated by Alternative			
	Action			1	2	3	
1	*	X	*	1000	500	400	*
2	*	Y	*	0	3000	0	*
3	*	Z	*	100	0	900	*
1	*	Y	*	0	250	0	*
2	*	Z	*	600	0		*
3	*	X	*	100	50	0	*
.	*	.	*	.	.	.	*
.	*		*				*

Acres allocated for different management alternatives (1, 2, 3)

Data Matrix Generator For RAA - MAGE 5

In the preparation of data for the allocation analysis it is necessary to compile inventory information about the land base and the responses to various forest management activities. Also required is knowledge of benefit values and management costs of implementing an activity. MAGE 5 is a major component of RAA which can be used to aid in constructing this information.

A major feature of MAGE 5 is its ability to incorporate the element of time in the overall analysis. The concept of time-streams is used to describe how commodities, benefits and costs will change over time given a management action. An example of a time-stream may be illustrated graphically as:



The first graph depicts a time-stream where the commodity flow will be constant given application of management action 1. The second graph shows how the commodity output changes over time, if management action 2 were applied.

Given the planning team has stipulated several periods within the planning horizon the matrix generator will develop an average figure for the impact of an activity on a commodity. This figure is the average commodity output given that an activity can be implemented in any year of the period. For example, suppose that the planning horizon is ten years subdivided into two periods of five years each. A management action involving timber harvest might be applied either during the first period or during the second period. The values calculated by MAGE 5 for the matrix rows and columns are as follows (using previous sediment time stream graphs):

	Management Activity Involving Management Action (timber harvest) Applied In		
	present condition	first period	second period
Average sediment/ha/ yr in the <u>first</u> <u>period</u>	0.4	0.64	0.4
Average sediment/ha/ yr in the <u>second</u> <u>period</u>	0.4	0.68	0.64

Since the sediment yields are constant under present conditions in this land area, the average yields in each period are 0.4 cubic meter per hectare per year provided nothing changes. The average values for sediment yields where timber harvest is involved assume that the application of the activity to an acre might occur at different years in the period. For example, the timber harvest might take place in any one of the five years of the first period. The various possibilities and the subsequent time-streams for sediment yield per year during the first period are as follows:

Activity applied in	<u>Year 1</u>	<u>Year 2</u>	<u>Year 3</u>	<u>Year 4</u>	<u>Year 5</u>
First year	0.8	0.8	0.8	0.8	0.8
Second year	0.4	0.8	0.8	0.8	0.8
Third year	0.4	0.4	0.8	0.8	0.8
Fourth year	0.4	0.4	0.4	0.8	0.8
Fifth year	0.4	0.4	0.4	0.4	0.8

Note that if the activity is not applied until a later year in the period, the present condition yield of 0.4 applies to all preceding years. The average value of 0.64 for the sediment yield in the first period, shown on the previous table, is the sum of the sediment yield possibilities divided by their number, or $16/25 = 0.64$. The other MAGE 5 matrix entries are calculated in a similar manner (Betters, 1977).

This concept is used to develop average yearly values for resource uses or commodities and for costs and benefits. These values are stored in a matrix format which can be utilized by the linear programming allocation model.

The output from the LP analysis in RAA will indicate which of the alternatives requirements and constraints were limiting. It also shows

specifically what acreage amount in an AA was allocated to a particular management action and in what planning period. The output enables the planner to determine those factors which limited either the value of the objective function and/or the outputs of various commodities. It also shows surplus production over the minimum amount specified.

Evaluation of RAA -

The steps involved in operation of the RAA system may be briefly summarized as:

- a. development of land classification system (AA)
- b. evaluate analysis areas in terms of key uses or commodities and potential management actions
- c. set time periods, number and length
- d. develop various commodity and economic time-streams and generate matrix entries
- e. develop a management action allocation
- f. evaluate the allocation with respect to goals and evaluation criteria

The initial step, not unique to RAA, is of crucial importance to each of the subsequent steps as well as the final land allocation. This step creates a certain detail which affects both biological and economic response accuracy. Depending on the degree of delineation the variability within AA units can be fairly small or very large. This affects the accuracy of the overall results as well as the level of use suitability associated with each AA unit.

The homogeneity within an analysis unit should be based on that unit's potential use or output. For example, if the unit is not suitable for

timber harvest, it should not be delineated in detail to support accurate measurement in timber volumes. The criteria used to stratify should include these suitability ideas as well as cost/return characteristics as specified in S219.12. This land stratification, in part, addresses the NFMA regulations which specify the need for the vicinity of proposed actions, (S219.11).

While the stratification procedure does permit determination of resource output under differing management actions, RAA like other linear programming models does not handle the interactive effects across response unit boundaries. In other words, a clearcut action is presumed to not have an appreciable effect on wildlife numbers in adjacent areas. This is an inherent problem in all linear allocative models which assume each action is mutually exclusive of another.

Given the forest size, number of potential uses, and possible management actions it becomes easy to vastly increase the size of the problem with just a small increase in response units. As these response units increase in number the RAA model expands in size, almost exponentially. Under these conditions the question of being able to manage the data, the number of response time-streams, the programming cost, as well as time required becomes very important.

In using RAA time periods, their number and length must be set. This determination is normally made considering the requirements of the Resources Planning Act which calls for a plan review at least every fifteen years. This planning horizon should be subdivided in RAA considering the uncertainty of the future. For example, the fifteen year planning horizon may be broken down into annual time periods for the first five years followed by one 10 year period. The longer later period will involve less accurate estimates

but given the uncertainty of the future this level of accuracy may be all that is necessary. Of course, as with response units, the more time periods chosen the larger and more complex the model becomes.

The formulation and 'running' of different alternatives with RAA requires an objective function to be maximized or minimized. This objective function requires the determination of coefficient values for management actions. If the objective is to maximize net benefits then dollar benefit values for such outputs as wildlife, recreation and other traditionally non-market goods must be specified. While past research has addressed means of non-market good valuation a definitive procedure for doing so have not yet been developed. The NFMA regulations state, however, that guidelines figures will be given to individual forests regarding these values.

RAA appears capable of satisfying many of the NFMA requirements and can provide a means of analyzing alternative management plans. As was suggested RAA can utilize a stratification scheme which reflects similar costs and returns for timber management, (S219.12). RAA can mimic the biological system and the management standards and guidelines from planning premises to determine the output of goods and services, their timing and quantity, (S219.5f). These outputs can be compared to forest and regional goals. The costs associated with production of these outputs may be used to estimate investment, operating and related costs, (S219.5g). Finally, RAA can provide a measure of net public benefits representing a cost-efficient combination of management actions, (S219.5f).

In the process of meeting these requirements the outputs of timber resources must be considered as well as non-timber values, (S219.5g). However, in its present form RAA is basically a land allocation procedure that

lacks some of the more detailed timber scheduling attributes found in other models. Due to the increase in model size necessary to handle the finer aspects of timber scheduling activities, the model in its present form is incapable of meeting the time-place requirements of the regulations.

D. Timber RAM

The Timber Resource Allocation Method (Timber RAM) is a linear programming model whose primary capability involves scheduling timber stands for harvesting and treatment. Timber RAM develops harvest and reforestation scheduling plans and reports the resulting volumes, revenues and costs associated with them. Alternative objective functions can be used including: (a) maximization of harvested volume over some specified time period; (b) maximization of present worth of revenues from future harvests; (c) maximization of present net worth of costs and revenues; and (d) minimization of present value of costs. Timber RAM requires inventory data on forest stands and data concerning consequences of possible management actions for each stand type. Timber RAM attempts to meet constraints while maximizing/minimizing the objective function. Obviously, the maximization of revenues or minimization of costs is only one goal of forest management. Timber RAM attempts to recognize this by building constraints on the objective function which address other resource issues.

Timber RAM utilizes three computer programs in sequence to develop forest plans. The programs are: (a) Timbram-Matrix; (b) linear programming code; (c) Timbram-Report, (Navon, 1971). Building the LP matrix begins by grouping timber stands of similar silvicultural and economic features into timber classes. Based on these stand features a set of activities is devised for each class. An activity is a sequence of appropriate treatments extending from the present to the end of the planning horizon.

The Timbram-Matrix can be used to make calculations pertaining to the activities, thus greatly reducing data preparation time on the part of the user. The Timbram-Matrix develops a set of activities which conform to the user's guidelines for event schedules, harvest yields and cost and revenues.

The Timbram-Matrix also requires user specifications concerning objectives and constraints. Different objective functions may be specified for different decades in the planning horizon. Scheduling constraints can take many forms including area available for timber treatments, accessibility to those areas, minimum/maximum levels to be managed under specified activities, and levels of inputs and outputs for selected time periods. Periodic constraints can also be used to define limits for areas of special stock plantings. Through minimum/maximum acres available for activities the model addresses non-timber considerations. Using accessibility constraints those acreages available for certain treatments can be established to correspond with a roading plan.

The linear program code uses the Timbram-Matrix to find the combination of activities and associated acres which best meet the specified objective. Variations on the objective function, the constraints or the activities themselves, can be used to construct alternative matrices and their resulting LP solutions.

The final Timber RAM program, Timbram-Report, is a report writer which translates the optimizing activities into schedules and tabular displays of outputs including cutting and reforestation schedules and a harvest graph. The schedule lists the number of acres to be managed by activity and the costs and returns associated with each activity. The report and

graph summarize the information over all the activities to show total outputs and inputs by period, and total harvest over the planning horizon.

Evaluation of Timber RAM -

In the planning process Timber RAM can be used to develop a scheduling of events with associated costs and revenues. Though primarily directed at timber management other land and resource concerns can, to a degree, be incorporated into the model. However, Timber RAM has very specific limitations when used to devise programs for multiple resource management as specified by the regulations. These limitations are related to the formulation of the model itself as well as linear programming in general.

In their article, "Evaluation of Forest Management," Chappelle, Mang, and Miley (1976) critically review the appropriateness of Timber RAM for the purpose of multiple resource forest planning. Some of their criticisms are useful here in establishing limitations of Timber RAM in light of the NFMA regulations.

Timber RAM has primarily been used to develop functional timber plans which were then integrated with other functional resource plans. The NFMA regulations require multiple-use plans derived through an interdisciplinary, as opposed to a functionalized approach. This being the case certain attributes of Timber RAM as a forest planning model might not be applicable. Specific features of Timber RAM will be pointed out to show inconsistencies with these regulations.

Timber RAM fails to explicitly consider the integrated nature of the living resources and use these interactive elements and information in the development of alternative plan formulations. A basic example of this pertains to the areas of timber classes to be cut. There is no means of

constraining the size of cuts which may be called for, and a total class may be specified for cutting. In doing so, important considerations of natural regeneration and environmental protection are neglected (Chappelle, et al, 1976).

As a long range planning model, Timber RAM cannot accommodate the changing values in factors of production. To suggest that costs of management activities and stumpage values will remain fixed is only truly viable in short range planning situations (Chappelle, et al, 1976).

Timber RAM has a very limited capability of accepting objective functions other than those involving costs and revenues except through the addition of "indirect" limiting constraints. Public forest management demands consideration of social, political and diverse environmental goals which Timber RAM essentially ignores. Linear programming by its mathematical design, develops allocations based on a single goal or objective with other goals serving, when possible, as constraints. As such, from a multiple goal, multiple resource view the solution is not truly an "optimum" but rather a satisfying solution. Chappelle, et al, point out that this problem may be partially overcome by "linking Timber RAM with a model (such as RAA) having the capability of allocating the total resource pool to the production of a complete range of alternative forestry outputs."

A major spatial consideration associated with Timber RAM is the grouping of stands similar in economic and environmental characteristics. This is, in terms of timber management, required in the NFMA regulations, "(S219.12). However, this aggregation creates problems in identifying treatment location. This does not meet the regulation requirement of defining "proposed vicinity and timing, ... of proposed and probable management activities, (S219.11,H4). Further, this aggregation inherently creates difficulties in accounting for

biological interactions of management treatments on areas adjacent one another. Whether an optimization program could be constructed to handle the myriad of possible interactions and cross-interactions between unit boundaries remains to be seen, but it is obvious that such a model would need to be different than the standard linear programming format.

Finally, Timber RAM should not be relied upon to develop forest management plans since the model in its present form cannot develop optimum solutions with regard to other resources involved in public forest management. However, Timber RAM can help address several phases of the conceptual planning framework including the development and analysis of alternative courses of action. In doing so, it can, in part, achieve goals established earlier; however its primary strength lies with timber scheduling. If linked with another model, such as RAA, a system could possibly be constructed to handle allocation of resources over time, to a wide range of forest outputs. The Timbram-Report, translating activities into schedules and displays of outputs, and associated costs and returns of activities, could be utilized by other analysis tools such as input-output analysis.

E. Development of MUSYC and FORPLAN

All of the models to be discussed in this section are concerned with allocation of scarce resources to a variety of uses, however, as will be pointed out the Model I, Model II and MUSYC models, constructed prior to FORPLAN, are primarily oriented to timber resources.

The first two model formulations to be discussed are titled Model I and Model II, after work by Johnson and Scheurman. Both of these tools are linear programming models designed to handle timber harvest scheduling problems. A brief discussion of the basic differences in these two models follows.

In Model I, the acres of timber harvested each period in a timber class form a management unit whose integrity is retained throughout the planning horizon. Each activity (column) in the linear program represents a possible management regime for a particular management unit, for the entire planning period.

Model I requires more activities than Model II to formulate the same basic case problem. This is due to the many possible cutting ages for timber. Since Model I represents each combination of timber class and cutting period as a different activity, many activities are required. These management activities have two parts: (1) a sequence of intermediate and regeneration harvests throughout the planning horizon and, (2) an associated cultural treatment. Because of incomplete enumeration of all possible rotation combinations the Model I structure may have a higher probability, compared to Model II, of resulting in an infeasible solution. However, treatment schedules on a given acre over multiple rotations are somewhat easier to follow in Model I because acres initially cut in a timber class are kept in that class over the entire planning horizon. Timber RAM is a Model I-type formulation. In Model II, the existing timber in each timber class forms a management unit until it is harvested. All acres harvested in the same period, that are assigned to the same regeneration class, form a new management unit until they are again harvested. The linear program combines the cutting of existing timber with particular rotation over resulting in significantly fewer activities (regimes) than Model I. This also enables Model II to include more rotations combinations than Model I.

Both MUSYC (Multiple Use Sustained Yield Calculation) and FORPLAN (Forest Planning Model), an extension of MUSYC, have little or no official

documentation. Due to this problem comments concerning these models will necessarily be brief and limited to basic conceptual characteristics.

MUSYC is a modification of the Model II-type formulation to include outputs other than timber in the model. However, MUSYC is still basically a timber scheduling tool even though it does have a limited capability for handling some non-timber outputs and activities. This addition to the Model II-type formulation was in response to the NFMA regulations calling for changes in allocation procedures so that there was active consideration of non-timber resources. MUSYC attempts to improve the necessary link between allocation for non-timber resources and timber harvest scheduling. In doing so, instead of defining analysis areas as non-contiguous areas, MUSYC more discretely defines the land base by sections of the forest.

FORPLAN is a new LP formulation or approach which is being tested and revised at this point in time. Nevertheless, the Associate Chief of the Forest Service has stated that FORPLAN will be the allocation and scheduling tool adopted by the National Forests for the development of alternative plans. The Lolo National Forest model, a FORPLAN formulation, links scheduling and allocation variables in the same linear program matrix. The Lolo effort is currently progressing with the aid of Dr. Norm Johnson of Utah State University, and Dr. Dan Jones and Ms. Sara Crim of the SAU-LMP, USDA Forest Service, Fort Collins, CO.

FORPLAN is composed of three components: (1) a matrix generator, (2) a linear programming code, and (3) a report writer. It is to be used, basically in the same manner as RAA but has several unique features which will be discussed from the user viewpoint.

The user must input several decisions and data sets to the matrix generator of the FORPLAN package^{1/}. The first set of decisions the user is called upon to make concern the planning horizon and length of periods within that horizon. The user may, for example, specify a 150 year horizon subdivided into periods of ten years each.

Next, specific decisions governing the type of timber harvest flow are required. The user may select from among four types including non-declining yield, preclusion of harvest decreases between periods, restriction of a period's harvest to a range in percentages about the previous period's harvest, and restriction to allow a period's harvest to vary within a volume range. An ending inventory constraint may also be specified to ensure a certain level of inventory volume present at the end of the planning horizon.

Cultural treatment and financial constraints give the user the ability to limit the acreage within a period which can be restocked, stocked with genetically improved trees or precommercially thinned. If any of these are used maximum expenditure or minimum revenue receipts for these actions may also be specified.

To allocate acres to uses and to track outputs the forest must be subdivided into areas. This is accomplished in the package by a hierarchical classification. The classification scheme permits unique definition using three "level" identifiers plus "working group", "land class", "condition class" and age of the existing vegetation criteria. The levels can include a general forest area such as watershed or some more unique descriptor such as wildlife

^{1/} It should be pointed out that the FORPLAN package, user's manual and guides are, as of this writing, undergoing revision. As such, the material shown here is tentative and changes are likely to occur before the model is finalized.

range. Working group, land class and condition class identify timber species, slope and timber size.

Having classified the land the user must identify scheduled and non-scheduled outputs to be tracked in the formulation. As defined in FORPLAN, scheduled outputs are those whose level depends not only on the prescription chosen but the timing of its application as well. Non-scheduled outputs are those such as visual retention acres whose number is based solely on the prescription chosen, not its timing. Scheduled and non-scheduled outputs can be constrained by controlling the amount of outputs or acres used in a particular fashion. Further the user can restrict the type of harvest cuts as well as logging method employed.

In FORPLAN the user may select from ten possible objective functions. These include maximization of returns, minimization of costs, maximization under a downward sloping demand curve for timber, and maximization or minimization of certain outputs by period.

The user specifies prescriptions for the analysis areas using the classification as a guide. In its present form the user may specify up to nine prescriptions per analysis area with a total of 3000 possible in the FORPLAN package. For each analysis area the user must pick a volume table to be used by the matrix generator as well as pertinent economic tables. Other parameters must be specified including thinning cycle, and timing for harvest. Finally the user must specify harvest type (clearcut, shelterwood, selection) and appropriate logging method. Prescriptions for other resource lands and areas unavailable for harvest have similar parameters which must be determined by the user.

The last set of information needed by FORPLAN concerns economic data such as interest rates for discounting and for use in reports, and demand curves and related data if required by the objective function. Costs and prices of all actions such as logging, sale preparation and outputs such as timber must also be entered. Once all necessary data entries and decisions are made the matrix generator will arrange this input in proper form for LP analysis. Once a solution is developed, the FORPLAN report writer uses the data input for the matrix generator and the LP solution to display pertinent information. The report writer lists, by area, timber stands available, and unavailable, for harvest as well as resource lands available, and unavailable, for other vegetative manipulation. This information is reported for each hierarchical strata. All constraints such as those for harvest flow, outputs, cultural treatments, acreage, and ending inventory are listed for review. Prescriptions by land group are listed and followed by timber and resource yield tables. Economic parameters and data entered by the user are summarized for review.

The LP solution report states the status of constraints, i.e., non-binding, binding, infeasible, etc. It also points out how closely the restriction was to its stated limit and finally, the maximum impact on the value of the objective function relaxing the constraint by one unit. (Shadow prices/opportunity costs).

Next the LP allocation is listed by hierarchical levels and size of area. The results of this allocation are displayed in a variety of tables showing:

- outputs by period
- timber output detailing yield by working group, by land class, by harvest type and logging type
- various additional harvest reports
- costs per acre per period for roading and logging
- cultural treatment costs by period, and total area

- non-timber outputs; volumes, cost, and price
- revenue by period
- economic report by period displaying net revenue, PNW @ 6%, PNW @ 10%, net benefits, PNB @ 6%, PNB @ 10%.
- inventory report of timber harvest and histograms by period

The resource output information provided in the reports can play an integral part in economic impact analysis of alternatives including input-output analysis, a subject of the next chapter.

F. Conclusions

Development and analysis of multiple resource management plans must respond to many requirements. Crucial among these is the need to develop estimates of physical, biological and economic effects of plans. The approaches outlined in this chapter, to a certain extent, help meet these needs. The FORPLAN model is being structured to provide these capabilities. However, a linkage of Timber RAM and RAA might be formulated to provide a similar functional capability.

Of the models and formulations discussed FORPLAN is probably best suited to address the USFS needs. As such, FORPLAN is the recommended formulation to address the requirements of the NFMA regulations. Unlike the other approaches, FORPLAN is being structured as a multiple resource planning tool. Continuing development and documentation should give the National Forest System an approach or tool which will help in designing appropriate plans.

CHAPTER V

ECONOMIC AND SOCIAL IMPACT ANALYSIS

A. Introduction

The impacts of each alternative plan are likely to take several forms. These forms, in general groupings, are: 1) the effects on the outputs of goods and services and their availability through time, 2) the effect on the physical and biological environment, and 3) the effects on the social and economic environment. Many forms of analyses are possible in areas of biology, sociology, economics and environmental design to estimate the full range of impacts. This chapter will emphasize those applicable to social and economic impact analysis.

A number of economic-based problems confront the development and analysis of alternative plans. One problem involves projections of demand for both traditional and non-market goods and services. Tools useful in demand forecasts include time series techniques, trend analysis, regression and correlation, and polling. Demand projections assist in establishing resource allocations to satisfy recognized needs as well as serving as criteria to judge the plan's effectiveness. These economic problems also extend to estimating future costs and values. As in other analyses there is a tradeoff between a high level of detail and accuracy and the time and expense required to develop the detail. Presently guidelines are being constructed to assist in answering the valuation problem for a range of resource outputs including timber, range, water, minerals and on-site uses for recreation, wildlife, fish and wilderness. The valuation of these on-site uses will, in part, be derived from the 1980 RPA.

Survey methods such as willingness-to-pay studies have been investigated for measuring the value of recreation experiences and wildlife-related activities. Basically, these methods require the researcher to ask users how much they would pay for the experience, such as camping, or conversely, how much they would sell their 'rights' to the activity. These responses can then be used to estimate a value for the activity/experience.

Another general technique for estimating value of non-market goods or services such as recreation is called the travel cost method. The value is defined as a function of number of visits, the cost of the trip, and the population of a particular user area. An estimate of both use and value is made allowing a demand schedule to be derived for the recreation site and experience.

Many types of analysis are possible given the broad range of regional impacts of alternatives. The specific approaches or techniques to be discussed in this chapter include input-output (I-O), and social impact analysis. Input-output is an analytical tool which depicts demand and supply relationships in an economy and estimates direct and indirect economic impacts given a change in the economy. Social impact analysis is basically a non-analytical information gathering and processing procedure which identifies important social, cultural and economic variables.

B. Input-Output Analysis (I-O)

A planning strategy or alternative generates a level of resource uses or outputs. Other alternatives will yield different sets of uses and outputs. Therefore, each alternative will produce a unique set of impacts on the local economy. This impact can be measured by estimating the change the alternative will produce in the present economy's condition. The basic economic factors to measure this change include employment by sector and

occupation, income, gross product and population. These factors serve as the basis for predicting effects in social and cultural environments. The first step in investigating change in local economic factors is the construction of a model which represents the flows and interaction in the economy. Several models exist which address this need (Isard, 1960). However, I-O has the broadest capabilities and has received the most attention in regional economic analysis.

The U S Forest Service has constructed I-O models for each of the nine regions and at the national level. Each of these models depicts the interdependencies found among producing sectors of the particular economy. These sectors produce goods and services which are consumed by other sectors of the economy. Each sector also purchases a set of goods and services which are inputs to its production process. The I-O model depicts these interrelationships in the sectors of the economy.

The U S Forest Service has developed a particular I-O model to use in the planning process. The three basic components in the I-O model are SCALE, CALDAT, and EA or Economic Analysis. The purpose of each sub-model will be discussed below.

The sub-model SCALE serves to aid in construction of an I-O model appropriate to a local area. In using SCALE, the analyst must aggregate data concerning final demand and total gross output by industrial sector for those counties in the region. This data is used as input to the SCALE sub-model and is coupled with industrial sector coefficients for the national I-O model. SCALE modifies the national coefficients to reflect local conditions. In doing so it is assumed that local industrial production functions are the same as national average production functions.

If an industrial sector is not present locally, or sector exports exceed the national average, for example, SCALE makes necessary modifications in the coefficients to reflect these conditions in the local I-0 model.

The sub-model CALDAT transforms the physical levels of resource uses and outputs into the total amount consumers pay for the product or activity in different sectors of the economy. For example, a change in the quantity of recreation visitor days may generate new direct sales in many sectors including: food products, retail sales, services and so on. Other forest outputs will each generate sales in one or more sectors. This type of information is used by the sub-model EA, the actual input-output model. Table 8, generated by the EA sub-model shows the part of the beginning structure of the I-0 model. The sectors of the economy are listed on the left side of the table. The original final demand column represents sales in the previous year. The original sector total gross output (TGO) is the total sector sales within the region. The difference between the two is that amount used in the production process itself.

The next set of columns in Table 8 list sets of coefficients for imports, employment, income and value added. These coefficients represent the per dollar amount each category would change by if the total output changes by one dollar. Value added is the purchases from households, governments and capital investment per dollar total gross output for a particular sector. The type 1 multiplier represents the interrelationship between producing sectors and serves as a relative gauge of the importance of the sector in the regional economy.

At this point the basic form for the previous years final demand and TGO has been constructed. These figures can be used to analyze the alter-

Table 8. Basic Regional Economic Structure for I-0

FOREST SERVICE REGION 2--ECONOMIC I/O MODEL (1977 \$) CJP/WLS/GSA/THW

ORIGINAL DATA

SECTOR	ORIGINAL FINAL DEMAND (\$MIL.)	ORIGINAL I/O (\$MIL.)	IMPORT COEFF. (IMP/%)	LABOR COEFF. (YEARS/%)	INCOME COEFF. (INCOME/%)	VALUE ADDED COEFFICIENT (V.A./%)	TYPE I OUTPUT MULTIPLIER
1 AGRICULTURE	7454.141	18663.1	.0436	.0175	.3133	.3409	2.2287
2 MINING	1343.933	3010.6	.0543	.0098	.5793	.6293	1.4489
3 CONSTRUCTION	6932.030	8510.4	.1406	.0202	.3355	.3397	1.7096
4 FOOD + KINDRED PROD	7146.364	9930.7	.0821	.0082	.1508	.1847	2.5047
5 TEXTILES + APPAREL	291.091	405.7	.3375	.0310	.3070	.3109	1.2832
6 LUMBER + WOOD PROD	25.638	377.2	.1592	.0210	.3904	.3996	1.5889
7 FURNITURE + FIXTURES	230.891	292.3	.1826	.0265	.4189	.4258	1.4731
8 PAPER + ALLIED PROD	37.125	328.5	.2550	.0198	.3459	.3545	1.4313
9 PRINTING + PUBLISH	581.472	1240.5	.1543	.0306	.4659	.4728	1.4633
10 CHEMICALS + ALLIED PROD	544.173	2678.1	.1465	.0081	.3251	.3327	1.7869
11 PETROLEUM REFINING	1056.333	2094.4	.0545	.0040	.1049	.1879	2.1358
12 RUBBER + MISC PLASTIC	515.232	1090.0	.1810	.0172	.4112	.4530	1.4609
13 LEATHER + PRODUCTS	180.280	222.3	.1690	.0229	.3460	.3498	1.6592
14 STONE, CLAY + GLASS	380.347	1008.7	.0907	.0196	.4612	.4727	1.6242
15 PRIMARY METALS IND	5.649	1029.4	.1625	.0155	.3424	.3523	1.6596
16 FABRICATED METAL PROD	240.957	1385.9	.1745	.0203	.3740	.3810	1.5863
17 MACHINERY EX ELECTRICAL	1523.663	2313.8	.1394	.0215	.4195	.4266	1.5820
18 ELECTRICAL MACHINERY	750.381	1200.7	.1307	.0263	.4740	.4808	1.5089
19 MOTOR VEHICLES + TRANS	2171.649	2702.0	.1919	.0171	.3326	.3588	1.5665
20 ALL OTHER MANUF	1201.951	1605.2	.1219	.0219	.4377	.4484	1.5912
21 TRANS, COMM, UTILITIES	4286.330	8769.3	.0360	.0461	.5412	.5989	1.5590
22 WHOLESALE TRADE	2546.826	4448.8	.0503	.0325	.5461	.6771	1.3989
23 RETAIL TRADE	6009.610	7107.7	.0299	.0697	.6347	.7870	1.2622
24 F I R F	6294.849	10369.2	.0366	.0132	.5505	.6726	1.4358
25 SERVICES	5967.111	9418.0	.0742	.0476	.5180	.5284	1.5693
26 GOVT + ALL OTHER INDUST	1012.140	2486.5	.0731	.2867	.4602	.4624	1.7190

(from, A User's Guide to A Computer Program For Economic Impact Analysis of Employment, Income, Output and Value Added Within A USDA Forest Service Region and the Total United States, by Charles J. Palmer, USDA Forest Service, 1979)

native plans impact on final demand figures. The model is used to calculate the total final consumer expenditure for the outputs generated by the alternative plan. The industries who produce the products from these outputs, in turn, earn an income. This value is a change in final demand for the industry sector making the sale. The model traces through supporting sales made by other industries to this industry to find the total gross output due to the change. The impacts on the set of indicators (imports, labor, income, value added) are found by returning to the previous table where the co-efficients appear. For example, if one takes these coefficients times the new TGO the impact on labor can be found for each sector. The labor indicator is derived by multiplying the labor coefficient, agriculture for example, by the new TGO for agriculture:

Labor coefficient		new TGO		Labor indicator
.0175	*	8.976	=	0.157
years/\$		\$Mil.		M. Person years

Table 9, then, displays the direct plus the indirect effect of the change in output on the economy. The direct effect is the immediate impact of sales in sectors directly affected by increased forest outputs. As sales increase these industries will require more input from other industries creating the indirect effect.

Also, found at the bottom of this table is the change in population generated by the change in outputs. This information is used to calculate the induced effect of the output change. As more activity is generated the area population increases and this increased final consumer income will also affect the TGO and set of indicator values.

Evaluation of I-0 using input-output analysis the planner can trace the impacts of the alternative's outputs through the economy. Different strategies will generate different outputs and will result in varying

Table 9. Direct and Indirect Effects From An Alternative Plan

FOREST SERVICE REGION 2--ECONOMIC I/O MODEL (1977 \$) CJP/WLS/GSA/IHW

ALTERNATIVE TEST ONE

ACQ 1						
SECTOR	FINAL DEMAND (\$MIL.)	TOTAL GROSS OUTPUT (\$MIL.)	IMPORTS (\$MIL.)	LABOR (M PER YRS.)	INCOME (\$MIL.)	VALUE ADDED (\$MIL.)
1 AGRICULTURE	.000	8.976	.391	.157	2.812	3.060
2 MINING	.309	24.122	1.309	.237	13.973	15.179
3 CONSTRUCTION	36.251	42.684	6.003	.861	14.320	14.499
4 FOOD + KINDRED PROD	8.019	13.119	1.077	.107	1.978	2.423
5 TEXTILES + APPAREL	.217	.525	.177	.016	.161	.163
6 LUMBER + WOOD PROD	4.303	7.046	1.122	.148	2.751	2.816
7 FURNITURE + FIXTURES	.341	.624	.114	.017	.261	.266
8 PAPER + ALLIED PROD	.254	1.360	.347	.027	.470	.482
9 PRINTING + PUBLISH	.207	3.660	.565	.112	1.705	1.731
10 CHEMICALS + ALLIED PROD	2.289	8.284	1.213	.067	2.693	2.756
11 PETROLEUM REFINING	38.098	43.695	2.380	.175	4.582	8.208
12 RUBBER + MISC PLASTIC	.159	2.325	.421	.040	.956	1.053
13 LEATHER + PRODUCTS	.016	.138	.023	.003	.048	.048
14 STONE, CLAY + GLASS	.052	2.992	.272	.059	1.380	1.415
15 PRIMARY METALS IND	.000	5.146	.836	.080	1.762	1.813
16 FABRICATED METAL PROD	.473	5.708	.996	.116	2.135	2.175
17 MACHINERY EX ELECTRICAL	2.122	5.024	.700	.108	2.107	2.143
18 ELECTRICAL MACHINERY	2.927	6.292	.822	.166	2.983	3.025
19 MOTOR VEHICLES + TRANS	5.042	7.554	1.450	.129	2.512	2.710
20 ALL OTHER MANUF	22.963	26.601	3.244	.582	11.643	11.927
21 TRANS. COMM. UTILITIES	2.197	24.283	.873	1.121	13.142	14.544
22 WHOLESALE TRADE	1.064	7.220	.363	.235	3.942	4.889
23 RETAIL TRADE	19.848	23.916	.715	1.667	15.179	18.822
24 F I R E	.850	13.837	.506	.183	7.617	9.307
25 SERVICES	25.758	39.018	2.896	1.859	20.210	20.619
26 GOVT + ALL OTHER INDUST	36.762	41.722	3.050	11.961	19.199	19.293
INTERMEDIATE TOTAL	211.522	365.871	31.867	20.230	150.523	165.365
MISCELLANEOUS		.000	.000	.000	.000	.000
TOTAL POPULATION 44063.			.000			
TOTAL	211.522	365.871	31.867	20.230	150.523	165.365

(from, A User's Guide to A Computer Program For Economic Impact Analysis of Employment, Income, Output and Value Added Within A USDA Forest Service Region and the Total United States, By Charles J. Palmer, USDA Forest Service, 1979)

impacts on sectors. This impact information is useful to the planner in estimating changes in social and economic activity in the area, (S219.5g,h.). The planner could use these results to calculate a "social" benefit measure to compare the costs of increased timber harvest, for example, with the total increase in economic activity. An analysis could also be performed to determine the contribution of each forest output to sectors of the economy, their total gross output and employment, (S219.5.g.9). Further, an I-0 model can provide useful information concerning impacts on specific employment groupings such as professional, technical, sales, clerical, farm labor and so on. Employment of groups such as women, minorities, and seasonal workers can also be traced by industrial sector (S219.5.g.5). I-0 can be used to test the impact of an even-flow policy or a particular regional economy.

I-0 has been used in several regions in river basin analyses, unit plans and Wild and Scenic River studies. I-0 was used in the RARE II studies around the country. I-0 proved beneficial in all these endeavors. The RARE II experience provided regional economists with experience concerning I-0 and several regions have now procured local data for the SCALE sub-model. Presently forests in these regions are using this local data in their respective USFS planning models.

Currently there is an ongoing effort at SAU-LMP to build an I-0 model general enough so as to be appropriate to many forests. This generalized version is preferred over construction of several "one-of-a-kind" models for individual forest's problems. This effort will require development of a comprehensive national data base at the county level.

Other types of economic analysis techniques are available including regional income, commodity flow, balance of payment, and economic base (or

export-base) analyses. However, these approaches are directed at particular facets of the economic system and are, in that sense, a partial analysis.

Two other approaches, mentioned earlier, are the industrial complex approach and interregional activity analysis, (Isard, 1960). The industrial complex approach is designed to combine some of the interindustry relationships with production economies of scale, localized economies and some regional price variations. Interregional activity analysis emphasizes regional interdependencies but, unlike I-O or industrial complex analysis, is an optimization technique. Given a set of limited resources, production technologies, and prices it attempts to allocate production activities to maximize profit, social gains, total income, employment or other objective. Work on this type of model is comparatively new and it has had limited applications.

The greatest problem with the use of the present USFS I-O model has been its incorrect utilization by the individual forest planning teams when dealing with their individual problems. The new system is being designed to try and avoid this difficulty and will include a new, easier to use, software package. Another problem which typically exists in using I-O models in general is that of determining the appropriate impact area. In other words, what counties should be included in the model to adequately model the impacts under question. This varies depending on the specific regional conditions that exist. It can be affected by the issues, involved, the outputs, location of sectors, etcetera. In many instances several levels of county aggregations may be appropriate for an analysis.

While the forest I-O models will be relatively easy to build and use under the new system, the interpretation of their results remains a problem

for users. Presently, handbooks are being prepared to respond to this need and other problems such as relating the results to the impacts on community infrastructure and maintenance of community stability. Another problem pertains to the compatibility of the I-O model with LP allocation packages. Many of the LP models have developed outputs inappropriate for use in the I-O model. For example, I-O requires knowledge of expected actual visitor expenditures by sector. Recreation capacity, like elk harvest, does not supply actual visitor estimates. Thus, it is important for the user to coordinate needs of the I-O model with the LP allocation package early-on in the planning process.

C. Social Impact Assessment

The analysis of social impacts of a forest plan is a major part of environmental impact analysis. Recent legislation including NEPA, RPA, and NFMA require the consideration of social values and social impacts in the formation, analysis and selection of a planned alternative. The first phase of the planning process, issue identification, makes it clear from the outset that public desires must be used to help guide the effort. Each subsequent phase requires consideration of not only the ecological environment but the social and economic environment associated with it.

Analysis of social impacts in the USFS has previously been primarily a sideline of economic analysis. Many socio-economic analyses have been highly biased toward the economic. Typically measures of social well-being such as gross national product are used in economic analysis, but this represents only one side of the picture. This segment examines other means of measuring well-being associated with a plan.

Social impact assessment is not a highly detailed, quantitative procedure. There are three basic steps to social impact assessment. They are: organization for the effort, the assessment itself, and the final presentation of the assessment. As will be seen, social impact assessment is, for the most part, a synthesis of social information gathered throughout the planning process. Public input approaches and techniques such as Delbecq, Delphi, Codinvole, and PUBLIC would provide much of this information. In effect, social impact assessment organizes and synthesizes this information to build a set of crucial social values and representative to the public. Against this background social impact assessment works to compare the probable social impacts of a plan alternative with desired social-cultural values and wants.

Selection of Variables

The initial phase of the process requires the selection of pertinent variables which represent needs and desires of the public. There is no standard list of variables, although a guide is provided in the new USFS handbook. Special consideration should be given to variables which are linked to changes in forest outputs given a management alternative.

Inventory

Once a set of "change" variables has been developed information must be gathered in terms of these variables. Public participation tools such as Delphi, Delbecq, Condinvole and PUBLIC may play an integral role here. These variables will provide pertinent information on present social characteristics and trends. The social trends may aid in the formation of appropriate alternative plans and the prediction of social impacts given a set of management actions. Four basic types of social data are useful in the

approach. They are: statistical social data, written social data, observational social data and respondent-contact social data, (Forest Service Manual, 1977).

Statistical social data is that commonly collected by the U S Bureau of the Census including demographic employment and income information, for example. However, many other forms of data are also available which help describe the local community, e.g., tourist visitation and expenditures, business sales, provision of public services in the local area.

Written social data can include a great many forms of public expression such as personnel letters, petitions, newspaper articles, historical profiles, newsletters, and so on.

Observational data is information collected to record a group's behavior. This data may include results of important public meetings or hearings, and other group activities. This data is probably the most nebulous and difficult to gather and factually present.

Interviews, response forms and surveys represent the respondent-contact social data. Unlike the other types of social data, here direct contact is made with people to solicit their views or attitudes about a particular subject. This approach can be very expensive, time consuming and require a systematic design to yield truly representative information.

Social Impact Assessment

The next step in preparation for the assessment is carried out through use of the variables and relevant data. These inputs are used to build past-to-present relationships which illustrate the distinguishing features of the society. Because plan alternatives will affect these relationships knowledge of trends will aid in assessing future impacts. This will benefit the team

by allowing them to concentrate efforts on particular types of data collection and enabling them to develop better understanding of the local communities.

Based on the materials developed above the planning team begins the social impact assessment. The assessment seeks to relate management alternatives to future conditions in society. The handbook proposes a series of means to investigate the impacts of actions. Scenarios are one means in which future conditions in society are described. There may be one or more alternative futures built for a community. This scenario is then utilized to estimate the impact of the various management alternatives on those futures.

Another means of analyzing social impacts is the community comparison technique. This technique uses the results of forest management in similar community-forest areas to suggest what will be likely to occur in the present situation. If the data bases are similar the team can use this to determine what results or impacts are likely to occur given a management action. Although no two areas are truly identical a good deal of insight concerning impacts may be gleaned from this review. Other means of assessing key variable impacts, suggested in the handbook, include using expert opinion, population multipliers, and intuitive judgment.

Evaluation of Assessment

Final evaluation is the last phase of the assessment. This evaluation attempts to "rate" the relative importance of impacts associated with each alternative. Here the planning group may attempt to rank the acceptability of the various alternatives themselves. This task is obviously not an easy one. The entire team should participate in the evaluation. Care should be taken in developing a procedure which avoids scaling of unlike social variables

together or numerically scaling those variables not conducive to a numerical assignment. The procedure used should be carefully developed and documented prior to the actual review. This procedure will then provide the format to guide evaluation of the alternatives.

Evaluation of Social Impact Assessment

Staff members responsible for public participation should assist in the coordination and completion of this effort. Social impact assessment is not a highly structured, analytical process nor does a specific "formula" exist to guide collection, analysis and interpretation of data. However, the basic steps provided in the USFS handbook and materials related to those steps should provide sufficient guidance to develop information in a form suitable for use in several phases of the planning process.

Conceptually, social impact assessment readily lends itself to the phases specified in the planning framework. The major steps serve to specify and synthesize the information obtained in the phases of problem perception, development of goals and objectives, and planning premises. This information is used to isolate critical social variables and to develop scenarios of community futures. The impacts of management action on these scenario futures can then be estimated. Knowledge of these social impacts may assist in the construction of management activities which address public issues, (S219.5e). Using the scenarios the planning team can trace "the social effects of implementing each alternative," (S219.5g), and social effects on community members as well as the community infrastructure. In this regard the assessment and results of the I-O model may be utilized together to ascertain the full range of impacts (social, economic, cultural) on individuals, groups, and the community as a whole. The assessment

evaluation may prove of beneficial use in completing the "comparative analysis" of alternatives as called for in the regulations, (S219.5h). Finally, if thoroughly documented, components of the assessment may be used in the draft and final environmental impact statements to show the "due process" given social, cultural and economic concerns.

D. Social Economic Impact Assessment in Bureau of Land Management Planning

The BLM follows a procedure for social impact assessment not unlike that of the Forest Service although it is more highly specified. The agency has, for some time, emphasized a strong social-economic analysis in its planning process. In part, this has been because of the major socio-economic impacts that normally result from federal mineral leasing, an activity for which the agency is responsible.

The BLM uses a set of planning phases which parallels the planning "steps" used by the Forest Service for land management planning. The primary phases are development of a Social-Economic Profile, Planning Area Analysis, and Management Framework Plan. Social impact assessment and socio-economic information is part of each phase.

The Social-Economic Profile is a basic data source and background information guide for the entire planning process. The purpose of the Profile is to examine social-economic factors in the community to identify and analyze important problems, trends, and issues. The BLM state offices are generally responsible for guiding and facilitating its preparation. An agency wide computer system is available which can provide a portion of the information for the Profile. The BLM planning manual provides a high level of guidance for profile development. It requires four basic parts:

- 1) significant social-economic factors
- 2) local infrastructure

- 3) relationship to government entities, planning groups, interest groups and key individuals
- 4) district organization analysis

Social-economic factors include data relating to industrial sectors, income, production levels, employment and resource demand projections. Major categories concerning the general population include population numbers, income, employment, consumption patterns, socio-cultural values, land ownership and others.

The analysis of the local infrastructure examines systems such as transportation, public fire and police protection, utilities, and health facilities which support the well-being of the community. This information is used to estimate the impact of possible management alternatives on these systems as well as the limitations the systems themselves may place on potential management programs.

An analysis of the relationship of the BLM to other agencies is necessary to establish their influence on possible management actions. Many federal, state and local agencies or groups may have some control, laws or policy, which have an impact on the alternative. The last portion of the Profile, district organization analysis, analyzes the history of past management programs on BLM districts. This examination traces the past policies and actions which brought management to its present state.

The Planning Area Analysis, is the last step before development of the land management plan. This step examines social-economic, as well as environmental factors and values in the planning area. The socio-economic portion of this analysis is divided into four areas of concern:

- 1) social-economic analysis and economic demand projections
- 2) social values analysis
- 3) infrastructure and Bureau relationships
- 4) problems and issues summary

The social-economic analysis and economic demand projections use resource production, income, employment and population to develop various relationships between man and resources. The infrastructure and Bureau relationships portion of the analysis is basically a synthesis of that material developed in the Profile. The problems and issues summary searches through the analysis to isolate crucial problems and issues and summarizes them in relation to the various factors considered in those analyzes.

The last phase of planning in the BLM system is termed Management Framework Planning. This phase incorporates the information discussed above with pertinent environmental inventories to develop multiple use plans for designated areas. In brief, the phase begins by resource specialists developing a set of activity objectives and the rationale supporting selection of these objectives. Each specialist then prepares a set of recommendations to support the activity objectives. The district manager is responsible for reviewing these recommendation sets, conflicts between them, and interrelationships between proposed activities. Based on this review alternative management programs are proposed.

Models which have been used by the BLM include the Multi-regional, Multi-industry Forecasting Model, or Harris model, and DYRAM, Dynamic Regional Analysis Model. Both of these analytical tools can be used to forecast socio-economic impacts of proposed actions.

The Harris model uses a series of sector change-in-output equations which simulate activity in industrial sectors of a region over time. Variables in these equations include marginal costs of obtaining factors of production, land values, industrial output, population, etcetera. The model is 'driven' by using data representing changes from current economic situations. The results of the model permit the user to estimate gross investment, employment, population, labor force, income, personal consumption, total supply and total demand in a region. The Harris model has been used by the BLM in evaluating plans relating to timber, coal leases and offshore oil leases. (Betters, 1979)

DYRAM, primarily an I-O technique, develops income multipliers for 20 industrial sectors for any aggregation of counties based on population, employment and personal income data. DYRAM also accounts for the portion of sector inputs which are supplied locally and those imported. By inputting change in terms of sector employment or earnings, output from the model forecasts estimates are derived for changes in employment and net migration/population. DYRAM has been used by the BLM to analyze impacts of range, timber and mineral type plans. (Betters, 1979)

Evaluation of Social-Economic Impact Assessment In BLM Planning

It should be apparent that social-economic impact assessment in the Forest Service and the BLM have many similar features. Both provide a means of integrating social impact assessment into the overall planning process. It is evident that social impact assessment plays a most visible part in the planning in early steps of both processes. Under the BLM system social considerations are used well in advance of developing alternatives and actually guides their construction. The Forest Service also develops some of this information prior to development of alternatives but basically employs it for analysis of alternatives fostering a review criteria emphasis. Both the

Forest Service and the BLM couple the social assessment with a wide range of public participation techniques which help ensure full consideration of important public concerns. It would appear useful for both agencies to coordinate efforts pertaining to incorporation of social-economic impact assessment in planning. This is particularly true in the case of the analytical tools used and the information gathering process.

E. Conclusions

I-0 analysis, while only one of several tools capable of representing interactions between sectors in an economy is probably the best suited for use in forest level planning. The Forest Service is presently working to improve their model through acquisition of a new data base and redesign of the model itself. Its use in forest level planning is being improved by making the formulation more generalized and applicable to a wide bank of problems. Further, handbooks are being prepared to better guide its use and interpretation of results. Forest staffs should begin work on the I-0 analysis early in the planning process so as to have enough time to prepare the model, coordinate it with other models, and have sufficient time to access the presently limited availability of technical assistance.

Discussion in this chapter has also centered on social impact assessment as conducted by the Forest Service and the BLM. Within this segment an attempt was made to outline the general features of each assessment technique and its relation to the planning processes. Guidance for the assessment, provided in manual materials by the Forest Service and the BLM, varies widely. The BLM provides fairly specific detail concerning kinds, quantities and methods in which social data should be gathered and analyzed. On the other hand, the Forest Service guidance, at this point, is far less specific in addressing these aspects and therefore allows the individual forest to design an assessment procedure given its own particular situation and concerns.

CHAPTER VI

ANALYTICAL TOOLS IN A HYPOTHETICAL EXAMPLE

A. Introduction

This chapter discusses the use of recommended analytical tools in a hypothetical forest level planning case. A scenario approach will be used to illustrate the use of the Delbecq approach and the Codinvolve technique, techniques for public involvement and analysis of input; FORPLAN, a resource allocation and scheduling procedure; and input-output analysis, a procedure for estimating socio-economic impacts of forest management alternatives. This discussion will provide insight concerning the tools' operation and value in the context of the forest planning process outlined in Chapter II of this report.

B. Problem Perception and Identification

An individual forest staff is constantly called upon either directly or indirectly for change in output of resource goods and services, management emphasis (priorities), management practices or a combination of these. Problem perception and identification is a conscious effort by the forest ID team to investigate the merit and opportunities for change embodied in these requests. A scenario will now be used to illustrate a typical case study of problem perception and identification.

In this case let us assume regionally defined targets have been provided to the forest staff concerning wildlife habitat improvements, increased timber growth, improved and increased range allotments and reduction in sediment loading. On an annual basis these targets specifically call for increase of timber harvest by 7000 MCF, water production by

60,000 AC FT, a maximum of sediment stream loading of 150,000 cubic yards, an increase of 20,000 AUMs, and an elk numbers increase of 200. This input provides the ID team with a guide for planning. However, local public preferences and pressures will have to be addressed also. A host of forest users including the local timber industry, cattlemen, hunters, mining companies and recreationists had all expressed concern for future management.

The forest staff decided to develop a public interaction program. The forest planner had, in a recent meeting, noted that present programs were apparently not satisfying many of the staff's critics who have genuine concern for the forest future. Some of the problems brought to his attention by these critics apparently arose from a misunderstanding of the forest's programs. It is necessary, he pointed out, that a mechanism be established to effectively relay pertinent information to the public. In subsequent discussions the ID team and staff responsible for public participation developed a program built around two tools: the Delbecq approach and the Codinvolve technique.

The Delbecq approach was selected for several reasons. In recent months certain prominate local citizens had been critical of the effectiveness of past planning efforts on the forest. Furthermore, a local community newspaper had taken it upon itself to condemn personally members of the ID team because of their apparent unresponsiveness to community needs. Delbecq was selected because it is specifically designed to maximize direct public interaction with the forest planning team throughout the planning process. It can provide the participants with a basic working knowledge of the role and operation of the organization while at the same time allowing them a voice in program development.

To begin the Delbecq program the staff selected 60 interested persons with the intent of focusing on their personal concerns for the forest future. Included were local ranchers, several timber companies, an off-road vehicle club, the local chapter of the American Wildlife Alliance as well as a large group of "general" public. Also participating were representatives from the water conservancy district, the state department of wildlife, the state development corporation and commissioners from all contingent counties.

At the first meeting the forest supervisor introduced the basic role of the planning team to the group and encouraged their active participation in the program. The program leader next split the group into units of six to nine individuals. A staff member asked the unit members to individually record statements related to future management emphasis and criticism of present management and organization. One of these groups was composed of a rancher, a member of the wildlife group, an owner of a forest inholding, a member of a college crosscountry ski club, a manager of a local sawmill, a weekend recreationist, and a representative of the state development corporation.

Having allowed about 15 minutes the staff monitor asked each member to cite one problem which was then recorded on a board. The process proceeded until all statements were recorded. In brief, some of their statements took the following form:

- the rancher was concerned about the reduction in summer grazing range;
- the sawmill owner expressed concern about the increasing amount of dead timber in the recent timber sales and noted that the trend in decreasing timber size was posing problems in logging operations and

the mill was experiencing lower lumber recovery; the staff monitor responded indicating the need for mixing dead in timber sales as part of a control treatment program for prevention of further disease and insect damage;

- the recreationist pointed out that his wife, confined to a wheelchair, had limited access to many recreation sites and activities, while another group member expressed dismay at the visual impact of the increased road building activities on the forest;
- the wildlife group member suggested that environmental concerns implied in the National Environmental Policy Act were not weighted heavily enough in the allocation process, especially in light of the sawmill owners hint at larger harvests which, in his opinion, would only serve to load streams and reduce already fish populations;
- the state development corporation representative stated that given the predicted population growth rate for the area the forest should offer more opportunities for recreational activities, and suggested a ski area, proposed 12 years ago, had come of age for the forest.

Finally, with all statements made an open discussion was held allowing each a chance to speak his mind. Afterwards, a vote was held with each group member selecting those five problems most pertinent to him/her. The program leader then re-united all the groups for open discussion of each individual group's voting and an overall tabulation was made. In presenting the overall vote the leader highlighted similarities as well as conflicts between preferences. The vote, in order of preference, took the following form:

- *increased water yield
- *increased timber sales
- *improved fish and wildlife habitat
- *increased job opportunities in resource related areas
- *increased dispersed recreation opportunities
- *increased educational offerings by the forest staff
- *improved developed recreation facilities
- *improved summer grazing range

The meeting concluded at the end of one day with the selection of one or two representatives from each group to continue involvement in the later planning phases.

The first Delbecq meeting brought to light a number of conflicts over future resource use concerning diminishing grazing range, decrease in amount, size and quality of timber in sales, amount and access to developed recreation areas, requests for resource related jobs, a ski facility and others. The program leader used these conflicts to aid in developing a series of issues.

The Delbecq approach has one serious drawback - it is restricted to a relatively small "sample" of the public. To counter this problem, the leader considered general public meetings, seminars, survey questionnaires and other tactics. He chose to hold a public meeting coupled with a general call for written comments concerning the issues developed through the Delbecq workshop. Television, radio and the local newspaper will all be used to communicate the message.

After a week or so passed, the staff had received over 500 written and oral responses from the public. Using the issues as a guide Codinvolve was used to separate the input received by type of respondent, ranking of their

reasons for preference on issues, types of responses for and against an issue, comments specific to a part of the forestor critical activities, etc. The response-type summary is shown below:

<u>Type</u>	<u>Inputs</u>	<u>Signatures</u>
personal letters	446	459
petitions	16	81
response forms	62	72
oral statements	7	8
	531	620

Based on the issues and comments raised in these 'responses and the Delecq meeting, the staff began the Codinvolve analysis. Codinvolve was used by the staff to efficiently analyze, store and summarize the input received. Initially the program leader and staff began a general review of the comments in order to get an overview of the issues. Next, the leader guided the design of a codebook and summary form. These two basic documents were build around the issue overview of the prior step. The codebook contained instructions, definitions and examples which showed how the response information should be coded. It served as a basic reference document for the coders to ensure that each coder's work would replicate that of the others. An example summary form is shown on the next page.

After the actual coding or transfer of public input, the next step was to sort the input in a manner which would help in analyzing questions. The input, recorded on edge-punch cards, was sorted by hand. The leader choose this method over a computer aided sort procedure since there was not a great volume of responses. The staff then prepared a report which summarized the information.

A part of the summary addressing extensive development of new developed recreation sites and activities is shown below:

	<u>FORM OF INPUT</u>				
	letters	response forms	petitions	oral	total
FOR	319	43	5	5	372
AGAINST	127	19	11	2	159

Reasons given in support of opinions expressed:

Reasons For

- (379) demand exceeds present facility capacity
- (258) present high use levels greater than natural capability of sites to withstand use
- (82) demand for new ski facility
- (56) new sites would allow greater access to isolated scenic forest areas
- (24) need for expanded horsemens facilities
- (8) need for disabled-persons recreation sites

Reasons Against

- (115) already sufficient areas
- (94) new roads to sites would detract from natural forest environment
- (49) additional facilities should be provided by private and other lands
- (35) too much motor-oriented recreation at present
- (28) expansion would prohibit other forest uses
- (24) crosscountry skiing should be encouraged over new downhill facilities
- (17) causes too much satellite development on unincorporated lands

This public input was used to augment the first Delbecq meeting and it served to point out many issues and conflicts not identified by the 60 participants.

C. Establish Goals, Policy, and Planning Premises

A second Delbecq meeting was held the next week after the staff had a chance to review the results of the first Delbecq meeting and the Codinvolve input together. This meeting followed the same general format as the first but involved some new participants in addition to the initial group representatives. These new participants were comprised of external and internal scientific personnel and specialists with expertise related to the issues. The program leader explained to the group that the purpose of the meeting was to elicit solutions to the problems and conflicts developed earlier. As in the first meeting, the program leader split the participants into small groups to write out solution ideas. As before, the staff monitor proceeded round-robin having each member suggest, one at a time, solution ideas, required resources and information needs for planning to confront these issues. The groups were then reunited to make general comments and discuss the suggested solution possibilities.

- a sociologist and economist pointed out the results of a recent study indicating major changes in the local population attitudes and life-style probably due to the growing industrialization of the area;
- a hydrologist expanded on that comment suggesting industrialization and growth would annex prime farmland requiring increased water yields from the forest for industry and public use;
- in light of this expected growth a recreation expert foresaw heightened use of undeveloped recreation areas and encouraged new emphasis on visual quality;

- wildlife experts expressed concern for fish habitat in light of possible increased sediment loading from new timber sales and the suggested water yield programs;
- a timber expert indicated more information on dead timber in relation to live timber in a sale is needed by potential buyers to fully evaluate the sale;
- the soil scientist and wildlife specialist suggested that several buffer strip systems will have to be used with timber harvests and practices to increase water flow, if fish populations are to rise to stable levels;
- a geologist suggests a large molybdenum site in the Backlash Mountain areas of the forest could yield a large quantity of trees, scarce resource, and the area is fairly isolated from most developed recreation areas.

This phase redefined problems from the first meeting and outlined certain means of attaining solutions as well as other new considerations. The results of this meeting were reviewed by the planning team. They determined that many of the proposals had merit although potential conflicts between them did exist and further investigation was necessary. At this review meeting one of the members noted that conflicts existed between the regional goals and the local perception of problems and needs. For example, the increased timber harvest will likely yield fairly high levels of sediment given the tracts of timber land to be offered for the next five years. The timber specialist also noted certain problems in maintaining a non-declining, sustained yield of timber in light of recent demand for substantially higher timber harvests.

Timing of this phase in the Delbecq approach is important to ensure this input is carefully reviewed by the planning staff. This review helps establish the planning premises and objectives which will guide, limit or constrain, the feasible range of alternatives. It allows the staff to express management concern and opportunities.

Having compiled the results of these Delbecq phases, the program leader prepared a "summary" report for the ID team. In doing so, the work of the original 60 participants, internal and external scientific personnel and organizational personnel was summarized to indicate both issues and concerns and concrete proposals. Unlike more "traditional" public involvement, the staff has used the Delbecq approach and the Codinvolve technique to involve interested publics and professionals to develop not just a set of issues and concerns but a program built upon them. The figure below indicates a portion of the "summary" report which helped to design the alternatives.

Figure 6. PUBLIC AND PROFESSIONAL INVOLVEMENT REPORT

Summary

REGIONAL DIRECTIVES

increase wood harvest by 7000 MCF annually
 increase range allotments by 20,000 AUMs annually
 increase water production by 60,000 AC.FT. annually
 reduce sediment loading by less than 500,000 cubic yards
 increase elk numbers by 200

DELBECQ PROGRAM
PARTICIPANTS

rancher (2)
 timber companies (3)
 off-road vehicle club (1)
 American Wildlife Alliance (1)
 water conservancy district (1)
 state department of wildlife (2)
 state development corporation (1)
 local county commissioners (6)
 owner of forest inholding (3)
 winter sports club (2)
 general public (40)

INITIAL MEETING
ISSUES

diminishing grazing range
dead timber in sales
decreased diameter classes in timber harvest
insufficient timber volumes with regard to mill capacities
limited access to developed recreation sites for the disabled
environmental quality
fear of heightened sediment, fish populations
increased opportunities for jobs and recreational activities given anticipated population growth
demand for new ski facility
etc.

INITIAL MEETING
VOTE
(by priority)

increased water yield
increased timber sales
improved fish and wildlife habitat
increased job opportunities in resource related areas
increased dispersed recreation opportunities
increased educational offerings by the staff
improved developed recreation facilities
improved summer grazing range

SPECIALISTS
MEETING RESULTS

increased industrialization population growth foreseen
study indicates major population attitude and lifestyle change
housing annexation of prime farm land will force use of marginal land with heavy irrigation needs
anticipated heavy increase in recreation use; emphasis on visual quality
concern for fish habitat in light of greater timber sale volumes and high water yield programs
need for dead timber salvage to retard disease and insect damage
need for additional information on dead timber component of dead timber sales
need for additional information on suitable sites, and impacts, for developed recreation
need for intensive management programs in conjunction with timber harvest sites to improve water yields while lowering sediment yield
suggestion to alter timber sale appraisals to more closely reflect small size product potential and lower lumber recovery
molybdenum site offers great potential in jobs and income to region but with impacts on developed recreation
suggestion for appraisal of existing and potential mineral resources should be completed before making any withdrawals or land use allocation which restricts mineral availability

MANAGEMENT REVIEW
RESULTS

conflicts exist between public priorities and regional directives
 future timber sale sites are prone to high levels of sediment yield
 potential conflict with non-declining yield of timber in light of recent demands for higher harvest and present stand structure of the forest
 note that many mills are operating @ 60 to 70% capacity
 conflict in maintaining present levels as well as assuring future levels of large diameter timber
 conflict between increased numbers of developed recreation facilities and access, and improved large game habitat
 conflict between livestock grazing and winter wildlife range
 question as to whether the forest should provide opportunities at all points on the recreational spectrum, and whether some kinds of recreation depend on and others appropriate to a forest environment

ALTERNATIVES
(by emphasis)

<u>CURRENT DIRECTION (#1)</u>	<u>ALTERNATIVE #2</u>
scenic beauty	water yield
water quality	timber production
timber production	scenic beauty
dispersed recreation	dispersed recreation
range	wildlife habitat
wildlife habitat	minerals
minerals	developed recreation range

D. Establish Objectives and Analysis of Alternative Courses of Action

At this point the planning team, with the aid of the public involvement tools has identified important public issues and management concerns in sufficient detail to outline strategies for alternatives. Now, the ID team must identify possible prescriptions to do the job. Simply put, a prescription is a set of actions scheduled through time which, when applied to suitable land, yield a range of resource outputs.

According to the planning framework developing the prescriptions requires a systematic collection of data and information to define the resource system. To define the resource system the team used "capability" areas for classifying the forest. A capability area is an area of land that is relatively homogeneous and would be expected to exhibit a uniform response to prescriptions. The criteria for delineating the areas was based, in large part, on its suitability for and response to prescriptions. Criteria were developed which helped to describe land and vegetative characteristics that were compatible with and necessary for the success of a prescription.

For example, a prescription guiding harvest of lodgepole pine was possible on land areas stocked with lodgepole or with the potential for growing lodgepole. This particular lodgepole pine prescription specified the type of harvest (shelterwood), the logging method (tractor, skidding), the volume required prior to initial entry, and the timing of the second entry. However, certain areas, though stocked with lodgepole, had steep slopes and were not capable or suitable for this prescription. Instead other uses or prescriptions, such as erosion control practices, would be appropriate in this case.

Since the team wanted to track the resource outputs of prescriptions, they had to estimate what effect the prescription would have on the outputs such as elk, water, sediment, etc. Response information for each capability area was required to reliably estimate these levels. Since sediment loading was a key public issue and regional office concern areas sensitive to erosion were carefully delineated enabling the team to keep close track of sediment impact there. The ID team used FORPLAN to determine what prescriptions should be applied to what analysis areas to produce desired objective

levels for resource outputs. FORPLAN is a linear programming tool which can be used to schedule activities through time given an objective. The staff economist recommended that the objective for the model should be to maximize the present net value of management costs and resource benefits over the 20 year planning horizon. The objective function had weights or dollar values assigned to all resource outputs associated with the prescriptions so that their contribution could be valued and summed. Because these outputs could occur in different years in the planning horizon the benefits were discounted along with costs, to give present net value. The team wanted to limit the amount of sediment to correspond with public desires and the regional directives so a constraint was placed in the model. The team also specified other constraints governing timber flow, elk numbers, cattle AUMs, water flow, and annual budget. Since the two alternatives represented different management emphasis, the objectives (levels of outputs) varied by alternative.

The annual requirements or constraints representing objectives for alternative 2 were:

Resource	Output	Period	Units	Alternative 2 annual requirements (R) or constraints (C)	
water yield	water	1	AC FT	60,000	
		2		60,000	(R)
timber	timber	1	MCF	10,000	
		2		10,000	(R)
wildlife	elk	1	No.	200	
		2		200	(R)
range	cattle	1	AUM	20,000	
		2		20,000	(R)
water quality	sediment	1	Cu Ft.	150,000	
		2		150,000	(C)
water yield	water	1	AC FT	50,000	
		2		50,000	(R)
budget		1	\$	3,000,000	
		2		3,000,000	(C)

TIMBER - non-declining flow

Table 10. Basic Linear Program Matrix of Per Acre Annual Yields by Prescription and Resource Output

OUTPUT/ACTIVITY	UNITS	ANALYSIS AREA #1 - BIG PINEY				ANALYSIS AREA #2 - BLUE MESA			
		PERIOD 1		PERIOD 2		PERIOD 1		PERIOD 2	
		PREScription #1	#2	#1	#2	PREScription #3	#4	#3	#4
DEVELOPED									
RECREATION	VDs								
DISPERSED									
RECREATION	VDs								
ELK	No.	.001	.002	.001	.001	.001	.003	.001	.003
GRAZING	AUMs	.2	.4	.2	.2	.2	.3	.2	.3
TIMBER	MCF	0	.41	0	1.7	0	1.5	0	1.7
WATER QUALITY -									
EROSION	CU YD	.1	.16	.1	.16	.2	.43	.2	.47
WATER									
PRODUCTION	AC FT	(.3)	(.4)	.3	.42	.3	.36	.3	.4
COST	\$	15	30	15	30	10	50	10	55
OUTPUT VALUE	\$								
NPV	\$								

Periods 1 and 2 were ten-year subdivisions with the 20 year planning horizon. Specifying subintervals allowed the planning team to keep closer track of output variations over the planning horizon. The requirements or constraints reflect the set of objectives constructed with the aid of public input, management concern and regional directives. A similar table was prepared for alternative 1.

FORPLAN also requires information concerning the results of applying a prescription. For example, the lodgepole pine prescription (prescription 2 in Table 10) could be applied in the first planning period. The forest hydrologists estimate the prescription, designed to remove 20% of standing volumes, will increase water yield from its present level of .3 AF/acre/year to an average of .4 AF/acre/year in the Big Piney analysis area. These response estimates became coefficients for the linear program matrix in FORPLAN. The particular values just mentioned are circled in the matrix shown in Table 10. The other coefficients were developed by appropriate members of the forest staff. This matrix construction required considerable time to complete and there was a good deal of cooperation and coordination required on the part of the ID team.

FORPLAN was used to select the set of prescriptions that best met the objective of maximizing present net worth. Each alternative, with its associated output goals, was analyzed independently. The following table shows the output results:

Alternative #1 -
present conditions

Alternative #2

	<u>period</u>			<u>period</u>	
Water	1	56,000		1	62,500
	2			2	66,500
Timber	1	4,500		1	10,000
	2	4,500		2	10,000
Elk	1	100		1	240
	2	100		2	230
Sediment	1	65,000		1	110,000
	2	65,000		2	89,000
Cattle	1	45,000		1	47,000
	2	45,000		2	48,500

The FORPLAN reportwriter also provided summaries of prescriptions applied in the analysis areas, per acre costs for roading and logging, revenue by period and others.

As is evident alternative #2, with its associated output goals and constraints, was able to meet, often exceed, the regional directives for the forest's output. Some resource output levels showed large gains over continuation of present management, alternative #1. However, due to increased cutting for timber and water yield programs, sediment stream loading increased by 53% in the first period and 27% in the second period compared to the sediment levels in the present condition alternative. Based on this increased sediment loading fish and wildlife experts predicted a 20% drop in stream fish populations over the next two decades.

The FORPLAN results were reviewed to determine what output goals were just met and which goals were more than met. Here the water yield goal was more than met. The timber specialist indicated that it may be feasible to lower timber harvest, reduce sediment yields while still meeting the water yield requirement.

This type of "sensitivity analysis" is important in using the FORPLAN package. The ID team can use the model to develop supply schedules for an output by changing the amount of the requirement and doing another analysis.

The team can determine which output levels are feasible and which are not. The opportunity cost or shadow price for each additional unit of a limiting resource or output requirement can give the ID team an idea of the marginal price/cost conditions at the optimal solution.

In this case the ID made additional "runs" and determined that timber surplus could be lowered to a certain degree if desired and all other output levels could still be met. At the same time, the sediment levels would be reduced to a more acceptable level. This type information would be useful later when the ID team met again with the Delbecq participants.

E. Evaluation of the Socio-Economic Impacts of Alternatives

In the previous section the ID team developed estimates of key resource outputs from the FORPLAN program. These are likely to have several social and economic impacts. The forest planner suggested an investigation would be required to "measure" these effects so that evaluation criteria, developed as part of planning premises, could be used to rank the appropriateness of the alternatives.

The ID team decided to utilize input-output analysis to aid in accomplishing this task. At a staff meeting an analyst who was assigned to study input-output analysis (I-O) presented a simplified introduction. Input-output analysis is an economic analysis tool which depicts demand and supply relationships in an economy and estimates the direct and indirect changes which would occur if an alternative were implemented. Continuing the discussion, the analyst stated that the resource outputs linked with an alternative would be used to determine the change they would produce from the present economic conditions. The measuring sticks or economic indicators used to observe this change would include employment by sector and occupation, income,

change in gross production and population. As would be expected if an alternative produced resource outputs significantly different from those that exist at present a change may occur in one or more of the indicators. In this case the substantial increase in timber available for harvest, could lead to large increases in sales of wood products, possible expenditures for logging equipment, personnel and so on.

In the next step the analyst constructed an I-O model which represented the flows in the local economy. Given the regional Forest Service model as a base the analyst adjusted it to the forest-level size using the SCALE submodel. Working with Forest Service regional office and Washington office support staff, the analyst set boundaries on the local model to reflect the local impact area. To accomplish this task counties were chosen which contained mills tributary to the forest.

The analyst transformed the amounts of resource uses and outputs from the forest alternative plan into the total amount consumers would pay for the product or service in different sectors of the economy. The submodel CALDAT performed most of this work. For example, the outputs of forest products are shown on the next table. In this test case the 10,000 MBF change in softwood timber would lead to approximately \$4,250,000 of sales in the lumber and wood products sector, #6. The economy was divided into 26 sectors of production as shown on Table 12. Other forest products would produce sales in yet other sectors.

The second table, Table 12, displays the basic sector structure of the local economy as developed with the aid of CALDAT. The original final demand column shows sales of each sector sold to final consumers. The TGO or original total gross output is the total sales of each sector. The difference

Table 11. Matrix of Direct Sales By Forest Output and Industrial Sector Due to Management Alternative

US FOREST SERVICE REGION 2 ECONOMIC IMPACT MODEL
ALTERNATIVE TEST ONE

			INDUSTRY SALES BY I-O SECTOR NUMBER (MM\$)								
OUTPUTS	UNITS	QUANTITY	4	11	20	23	25	1	2	6	8
1 HW SAWTIMBER	MBF	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
2 HW ROUNDWOOD	MCF	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
3 SW SAWTIMBER	MCF	10000.00	.00	.00	.00	.00	.00	.00	.00	4.25	.00
4 SW ROUNDWOOD	MCF	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
5 OTHER DEV REC	MHRVD	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
6 SKIING	MHRVD	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
7 DISPERSED REC	MHRVD	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
8 BIG GAME HUNTING	MHRVD	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
9 SMALL GAME HUNT	MHRVD	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
10 NON-HUNTING WL	MHRVD	3.25	6.11	37.50	14.10	19.83	16.93	.00	.00	.00	.00
11 FISHING-COMM	MLBS	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
12 FISHING-REC	MHRVD	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
13 GRAZING	MMAUM	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
14 ENERGY MINERALS	BBTU	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
15 LEASABLE MINERALS	STON	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
16 COMMON MINERALS	STON	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
17 NFS CAP INVEST	\$	23.56	.00	.00	.00	.00	.00	.00	.00	.00	.00
18 O & M ADM	\$	89.23	1.91	.59	8.86	.02	8.83	.00	.31	.05	.25
TOTAL	MM\$		8.02	38.10	22.96	19.85	25.76	.00	.31	4.30	.25

(from "A User's Guide to a Computer Program For Economic Impact Analysis of Employment, Income, Output and Value Added Within a USDA Forest Service Region and the Total United States", Palmer)

Table 12. Matrix of Per-Dollar-Change Coefficients by Sector and Economic Indicator; and Original Sales

FOREST SERVICE REGION 2--ECONOMIC I/O MODEL (1977 \$) CJP/WLS/GSA/THW							
ORIGINAL DATA							
SECTOR	ORIGINAL FINAL DEMAND (\$MIL.)	ORIGINAL I/O (\$MIL.)	IMPORT COEFF. (IMP/\$)	LABOR COEFF. (YEARS/\$)	INCOME COEFF. (INCOME/\$)	VALUE ADDED COEFFICIENT (V.A./\$)	TYPE I OUTPUT MULTIPLIER
1 AGRICULTURE	7454.141	18663.1	.0416	.0175	.3133	.3409	2.2287
2 MINING	1341.933	3010.6	.0543	.0098	.5793	.6293	1.4489
3 CONSTRUCTION	6932.030	8510.4	.1406	.0202	.3355	.3397	1.7096
4 FOOD + KINDRED PROD	7146.164	9910.7	.0821	.0082	.1508	.1447	2.5047
5 TEXTILES + APPAREL	291.091	405.7	.3375	.0310	.3070	.3109	1.2832
6 LUMBER + WOOD PROD	25.638	377.2	.1592	.0210	.3904	.3996	1.5889
7 FURNITURE + FIXTURES	230.891	292.3	.1826	.0265	.4189	.4258	1.4731
8 PAPER + ALLIED PROD	37.125	328.5	.2550	.0198	.3459	.3545	1.4313
9 PRINTING + PUBLISH	581.472	1240.5	.1543	.0306	.4659	.4728	1.4633
10 CHEMICALS + ALLIED PROD	544.173	2078.1	.1465	.0081	.3251	.3327	1.7869
11 PETROLEUM REFINING	1056.333	2094.4	.0545	.0040	.1049	.1879	2.1358
12 RUBBER + MISC PLASTIC	515.272	1090.0	.1810	.0172	.4112	.4530	1.4609
13 LEATHER + PRODUCTS	180.280	222.3	.1690	.0229	.3460	.3498	1.6592
14 STONE, CLAY + GLASS	380.347	1008.7	.0907	.0196	.4612	.4727	1.6242
15 PRIMARY METALS IND	5.649	1029.4	.1625	.0155	.3424	.3523	1.6596
16 FABRICATED METAL PROD	240.957	1385.9	.1745	.0203	.3740	.3818	1.5863
17 MACHINERY EX ELECTRICAL	1523.663	2313.8	.1394	.0215	.4195	.4266	1.5820
18 ELECTRICAL MACHINERY	750.381	1200.7	.1307	.0263	.4740	.4808	1.5089
19 MOTOR VEHICLES + TRANS	2171.649	2702.0	.1919	.0171	.3326	.3588	1.5665
20 ALL OTHER MANUF	1201.951	1605.2	.1219	.0219	.4377	.4484	1.5912
21 TRANS, COMM, UTILITIES	4286.330	8769.3	.0360	.0461	.5412	.5989	1.5590
22 WHOLESALE TRADE	2546.826	4448.8	.0503	.0325	.5461	.6771	1.3989
23 RETAIL TRADE	6009.610	7107.7	.0299	.0697	.6347	.7870	1.2622
24 F I R F	6294.849	10369.2	.0366	.0132	.5505	.6726	1.4358
25 SERVICES	5967.111	9418.0	.0742	.0476	.5180	.5284	1.5693
26 GOVT + ALL OTHER INDUST	1012.140	2486.5	.0731	.2867	.4602	.4624	1.7190

(from "A User's Guide to a Computer Program For Economic Impact Analysis of Employment, Income, Output and Value Added Within a USDA Forest Service Region and the Total United States", Palmer)

between these two measures is that amount of sector sales (intermediate) which is used in producing other final products. As is typical of lumber and wood products a great deal of lumber is sold as intermediate goods in the local economy, $377.2 - 25.6 = 351.6$. The remainder of the table lists coefficients, developed for the local area, which represent the amount a category, such as income, would change when the TGO changed by one dollar. The type 1 multiplier represents the interrelationship between producing sectors. The greater the value the greater the dependency of one sector upon other sectors for intermediate goods.

This formed the basic model for the analyst representing conditions prior to implementation of an alternative. Now the analyst was ready to "run" the outputs of an alternative through the I-O model to determine the direct and indirect effect of this change on the economy. The direct effect, the sum of products sold to final consumers, was reported as final demand as shown on Table 13.

The model then determined the sum of sales of supporting industries to those industries directly impacted. For example, the increased activity of the lumber and wood products industry generated a need for equipment and material supplied by the machinery and electrical sector, and the paper and allied products sector. The direct and indirect effects were summed to form the total gross output. For example, the lumber and wood products sector shows a final demand of \$4,300,000 representing the direct impact of the change in resource outputs. From Table 11 this sector (#6) received sales of \$4,250,000 from 10,000 MCF of softwood sawtimber. The sector also received \$50,000, a portion of the national forest operating maintenance and administrative (O,M&A) budget. Because the wood products

industry required goods from other industries to operate, the I-0 model traced through supporting sales to determine the TGO for the sector. This activity generated an additional \$2,743,000 in intermediate sales ($7,046,000 - 4,303,000 = 2,743,000$).

Now, back to the other economic measuring sticks: imports, labor, income, and value added. We must use the coefficients built for the area to show the economic impact of dollar change in TGO. For example, the overall change in agricultural employment related to the forest output was found in the following fashion:

$$0.0175 \times 8.976 = 0.157 \text{ M person years, or } 157 \text{ person years}$$

with

0.0175 as the labor coefficient representing person years of employment necessary to produce \$1 work of output (Table 12)

8.976 as the total gross output (TGO) for agriculture due to change in forest outputs

The last pertinent bit of information shown is the total new population supported by this alternative. This alternative supported a change in population of 4406. This, of course, would be well received by the state development corporation representative.

In the final step of the analysis estimates are made of the induced effect of the change. Thus far consideration has been only given to direct and indirect effects. However, as more activity is generated the area population grows and this has an effect on final demand for products, intermediate products necessary to produce them, and on the economic indicators.

This information was useful to the planners in predicting changes in social and economic activity in the area. The planners used the results to calculate

Table 13, Matrix of Direct and Indirect Effects of a Management Alternative and Impacts on Economic Indicators

FOREST SERVICE REGION 2--ECONOMIC I/O MODEL (1977 \$)

CJP/WLS/GSA/IHW

ALTERNATIVE TEST ONE

ACQ 1							
SECTOR		FINAL DEMAND (\$MIL.)	TOTAL GROSS OUTPUT (\$MIL.)	IMPORTS (\$MIL.)	LABOR (M PER. YRS.)	INCOME (\$MIL.)	VALUE ADDED (\$MIL.)
1	AGRICULTURE	.000	8.976	.391	.157	2.812	3.060
2	MINING	.309	24.122	1.309	.237	13.973	15.179
3	CONSTRUCTION	36.251	42.684	6.003	.861	14.320	14.499
4	FOOD + KINDRED PROD	8.019	13.119	1.077	.107	1.978	2.423
5	TEXTILES + APPAREL	.217	.525	.177	.016	.161	.163
6	LUMBER + WOOD PROD	4.303	7.046	1.122	.148	2.751	2.816
7	FURNITURE + FIXTURES	.341	.624	.114	.017	.261	.266
8	PAPER + ALLIED PROD	.254	1.360	.347	.027	.470	.482
9	PRINTING + PUBLISH	.207	3.660	.565	.112	1.705	1.731
10	CHEMICALS + ALLIED PROD	2.289	8.284	1.213	.067	2.693	2.756
11	PETROLEUM REFINING	38.098	43.695	2.380	.175	4.582	8.208
12	RUBBER + MISC PLASTIC	.159	2.325	.421	.040	.956	1.053
13	LEATHER + PRODUCTS	.016	.138	.023	.003	.048	.048
14	STONE, CLAY + GLASS	.052	2.492	.272	.054	1.380	1.415
15	PRIMARY METALS IND	.000	5.146	.836	.080	1.762	1.813
16	FABRICATED METAL PROD	.473	5.708	.996	.116	2.135	2.175
17	MACHINERY EX ELECTRICAL	2.122	5.824	.700	.108	2.107	2.143
18	ELECTRICAL MACHINERY	1.927	6.292	.822	.166	2.983	3.028
19	MOTOR VEHICLES + TRANS	5.042	7.554	1.450	.129	2.512	2.710
20	ALL OTHER MANUF	22.863	26.601	3.244	.582	11.643	11.927
21	TRANS. COMM. UTILITIES	2.197	24.283	.873	1.121	13.142	14.544
22	WHOLESALE TRADE	1.064	7.220	.363	.235	3.942	4.889
23	RETAIL TRADE	19.848	23.916	.715	1.667	15.179	18.822
24	F I R E	.850	13.837	.506	.183	7.617	9.307
25	SERVICES	25.758	39.018	2.896	1.859	20.210	20.619
26	GOVT + ALL OTHER INDUSTRY	36.762	41.722	1.050	11.961	19.199	19.293
INTERMEDIATE TOTAL		211.522	365.871	31.867	20.230	150.523	165.365
MISCELLANEOUS			.000	.000	.000	.000	.000
TOTAL POPULATION 4406				.000			
TOTAL		211.522	365.871	31.867	20.230	150.523	165.365

(from, "A User's Guide to a Computer Program For Economic Impact Analysis of Employment, Income Output and Value Added Within a USDA Forest Service Region and the Total United States", Palmer)

a social benefit measure, a benefit-cost ratio, comparing the direct and indirect benefits for the economy to costs of increased timber harvest. A similar analysis could also be performed to determine the contribution of the other forest outputs to sectors of the economy, their total gross output and employment.

The ID team made a further study of the social inputs of the alternatives, a "social impact assessment." As part of this assessment the ID team used a local Council of Governments population, industry and land use projection report along with other materials. In brief, the report outlined the current state of the "community" and the anticipated future state twenty years hence. This was based on historic trends in population growth, industrial growth, business cycles and land use. By comparing the resource output levels over the next twenty years and the result of the input-output analysis the ID team was able to make some determination as to the alternatives impact or a contribution to this "future scenario."

The Council's report stated that in the next twenty years area population was expected to increase by 65%, up to 227,000. With this population jobs would increase by approximately 40,000. Also demand for housing would greatly erode the present use of prime agricultural lands adjacent to the communities forcing use of marginal land. The demand for water would increase through communities attempting to provide essential public services and by farmers whose higher percentage of marginal lands would require additional amounts for irrigation. Many more citings held relevance to the production of goods and services available from the forest. In general, the alternative plans seem to mesh well with the trends in demand and future needs of the local communities.

F. Selection and Implementation of a Preferred Alternative

Armed with the information presented above concerning the analysis and evaluation of alternatives a final Delbecq meeting was held to re-involve the original participants. At the meeting the program leader and the forest supervisor presented the fully developed management alternatives to the group explaining the individual aspects and effects associated with each. In doing so the program leader highlighted the contributions of the alternatives to the original set of issues which the group had developed quite some time ago. After a period of discussion the participants, each supplied with summaries of the alternative programs were asked to carefully review it and respond with their preference(s) and remarks on a response form. The Delbecq meeting helped to set the design of a series of general public meetings held throughout the area with the purpose of explaining the alternatives. These meetings would solicit a second call for written comments. As before, Codinvolve was used to analyze and summarize the input received. Response to the second alternative showed the following result. See Table 14.

After careful study of all the comments received, input from the Delbecq program and the forest staff, the forest supervisor chose alternative #2 and began preparation of an environmental impact statement (EIS) to mark its selection.

With the latter acceptance of the EIS the ID team began the next step of implementing the plan. In doing so sets of annual programs or projects to implement the plan were considered. The staff could have used a linear programming model called ADVENT to aid in identifying the optimum mix of

Table 14. Codinvolve Summary of Comments Received In Regard to Alternative Plan #2

Alternative 2	<u>Form of Input</u>				Total
	Letters	Petitions	Reports	Response Forms	
For	82(I)	2(I)	3(I)	82(I)	173(I)
	90(S)	83(S)	3(S)	86(S)	262(S)
Against	31(I)	18(I)	4(I)	21(I)	74(I)
	35(S)	45(S)	5(S)	21(S)	106(S)

I = inputs, S = signatures

Reasons given in support of the opinions expressed

Reasons for

best for economy (151)
 provide jobs (111)
 provide mass recreation (61)
 other alternatives too restrictive (43)
 restricts intensive recreation (26)
 restricts roads (19)
 impact on local economy (9)
 restricts timber harvest (4)

Reasons against

already too many roads (72)
 need more wilderness (65)
 preserve for posterity (47)
 protection areas from development (31)
 protect areas from timber harvest (22)
 protect areas from general misuse (12)
 wildlife values (3)

(from "A Framework For Agency Use of Public Use of Public Input in Resource Decision-making",
 Hendee, Clark and Stankey)

annual work projects. PAMARS, a more recently developed Forest Service technique might have been used as an accounting tool to report on actual expenditures in plan implementation.

A critical final aspect of the planning framework is review and feedback. This is an activity which should go on not only during planning but in implementation as well. Simply put, review serves to compare results of implementation with the direction sought in the plan. If the cost for certain budgeted activities in the second year of implementation were found to be substantially higher than anticipated, as was the case on this forest, the staff would benefit by making careful note of this fact and, perhaps, redesign those activities to lower their cost in the future. The review is also of importance to ensure that the planning activities are fully documented and can be supported by the chosen plan.

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